RAILROAD GAZETTE

FRIDAY, MARCH 27, 1903.

CONTENTS

Contributions

Why Automatic in Preference to Controlled Manual?

Swissvale, Pa., March 20, 1903.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In Colonel Yorke's report on American railroads (lately made public by the Board of Trade) I find the following sentences:

"Automatic signaling does not of itself introduce greater safety of operation. It is merely a labor-saving device. No doubt it eliminates the risks due to mistakes of signalmen, but it introduces other risks peculiar to itself, due either to inefficient maintenance, to failure of the mechanism, to weather, and to accidents of various sorts. Moreover, the *chief object of a system of automatic signaling must be to enable more trains to pass over a given section of the line in a given time*, and more trains under such conditions necessarily involve increased chances of accident."

It is quite obvious that Colonel Yorke has not stated his thought very completely or with much care. It is not likely that he would deliberately suggest running fewer trains as a means of safety. Nor is it likely that he would deliberately suggest that automatic signals enable us to run more trains. Manual blocking permits the running of just as many trains as automatic blocking. It is merely a question of the length of the blocks, and that in turn is a question of wages. No doubt we could find denser traffic on main line steam railroads in England than in America.

We have in this country some very perfect automatic blocking, that has stood well the tests of time and weather and heavy traffic; but the controlled manual "eliminates the risks due to mistakes of signalmen," has the advantage of the constant presence of signalmen and will pass just as many trains. It is only a question of money.

BLOCK.

Economy of Different Types of Engines Using Superheated Steam.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There has appeared in the *Railroad Gazette* a number of articles on superheated steam. None, however, have shown its relative effects when used in the several types of engines.

The various results given herewith should not be compared with each other on the basis of water per horse power per hour, as pressures and other conditions are different, but the economy arising from the use of superheated steam over the use of saturated steam in the same engine can properly be compared by one percentage diagram.

The following tests [A. S. M. E., Vol. 21, p. 788) were made by Mr. E. H. Foster on a Worthington duplex direct acting triple expansion pumping engine having six cylinders arranged in tandems of three on each side. The engine was fitted with the Schwoerer patented superheater.

Test No.	1.	2.	3.	4.	5.
I.H.P.	106.3	106.8	103.1	105.	105.1
Superheat, deg. F.	0	0	118.6	122.5	117.7
Steam per pump h.p. per hr, lbs.	21.8	21.2	18.9	18.5	18.0

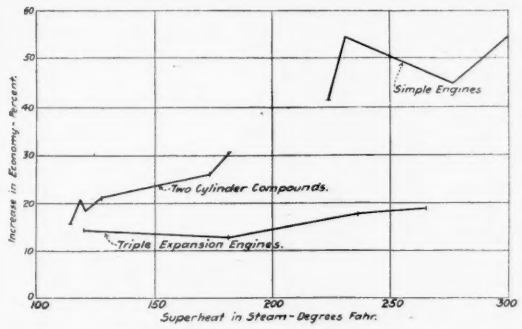
The average economy as shown by the above tests in using steam superheated 119.6 deg. F. is 14.1 per cent. over that of saturated steam.

Perry in the "Steam Engine" gives the results of several tests on a Corliss compound engine with steam jacketed cylinders when developing about 500 h.p. With saturated steam at 96 lbs. pressure the steam consumption was 19.8 lbs. per indicated horse power per hour, but when the steam was superheated 118 deg. F. the steam consumption dropped to 15.6 lbs., a gain of 20.8 per cent. Other tests on a single expansion engine equipped with a Schmidt superheater gave, when using saturated steam, an economy of 38 lbs. per i.h.p. per hour. When using steam with 300 deg. superheat the steam consumption was 17 lbs., showing 55.3 per cent. increase in favor of the latter method.

In a paper read before the Society of German Engineers in 1900, Oscar Hunger reported a test of a vertical cross compound pumping engine with 23.6 in. and 37.4 in. x 31.5 in. cylinders and running at 40 r.p.m. At 75 lbs. pressure the steam consumption was 20.5 lbs. with saturated steam. With steam superheated 180.5 deg. and a pressure of 150 lbs., the steam consumption became 12.9 lbs., or a gain of 30.7 per cent. over saturated steam at the lower pressure.

Again, tests of a 3,000 h.p. vertical triple expansion engine at the Berlin electric light works (*Engineering Record*, Vol. 42, p. 345) show that a gain of 12.5, 17.9 and 18.7 per cent. results from superheating the steam 181, 235 and 264 deg. F. respectively.

Other tests in Bavaria, with a Sulzer compound engine (*Engineering News*, Vol. 41, p. 213) give a gain of 16 per cent. with steam superheated 114 deg., 18.5 per cent. when superheated 121 deg., and 25.9 per cent. when superheated 173 deg. F.



Economy of Superheated Steam.

The accompanying diagram has been obtained from the above tests by plotting the degrees F. of superheat as abscissæ and the per cent. of economy as ordinates. Inspection of this diagram shows that the greatest economy results in the use of superheated steam in simple engine, as might be expected. On the other hand, marked economies are shown for compound and triple expansion engines, but the percentage of gain decreases as the number of expansions increase.

W. W. CHRISTIE.

Improvements on the Pennsylvania Railroad.*

BY S. WHINERY, C.E.

Improvements at Philadelphia.

As all roads led to Rome, so all the railroads of the Pennsylvania System may be said to center at Philadelphia. It might therefore be expected that the problem of handling its vast business in that city would be one of the largest and most difficult that the management must deal with. Some conception of the magnitude of this business may be formed from the following statistics. The total length of single track owned and controlled by the Pennsylvania in the city of Philadelphia is approximately 450 miles. The distance by the Pennsylvania Railroad from New York to Pittsburg is 445 miles, so that the trackage in Philadelphia is sufficient to build a single track road between those cities.

The number of passenger trains that use the Broad Street station every week-day is, according to current schedule:

Trains outbound	268
Trains inbound	262
Total	530

A census of the passenger business handled at this station in a single day was taken on June 1, 1901, with the following results:

Passenger trains arrived	260
Passenger trains departed	264
Total	524
Cars arrived	1,245
Cars departed	1,300
Total	2,545
Number of passengers arrived by trains	30,168
Number of passengers departed by trains	30,121
Total	60,289
Single tickets sold (exclusive of commutation)	39,906
Pieces of baggage handled, outbound	2,968
Pieces of baggage handled, inbound	2,262
Total	5,230
U. S. mail pouches, in and out	5,101
P. R. R. cab service in and out, trips	801
Number of meals served in restaurant	1,658
Number of letters and packages handled through station branch post office	1,600,570
Express packages handled	7,397
Information bureau, No. of questions answered	4,337
Information bureau, No. of time-tables given out	1,774

The records show that during the year 1902, 8,443,663 passengers arrived at, and 8,383,729 departed from the station—a total of 16,827,392 for the year. As the Sunday business is comparatively light, the above figures indicate that the average number of passengers in and out of the station on week-days was in the neighborhood of 50,000. This great station is itself worth our attention. Built in 1880 for the use alone of what was then the Pennsylvania Railroad, it was called upon to accommodate the other lines that have been since absorbed. It was enlarged in 1890, but has become so crowded that further enlargement is absolutely necessary, and the train shed, now 600 ft. long, will be extended 200 ft. This train shed is still one of the most remarkable structures of its kind. Its roof and sides are formed by a great steel elliptical arch having a clear span of 306 ft., with a rise at the center of 104½ ft. When it is recalled that the clear span of the arch of the Reading Terminal station in the same city is 259 ft. 8 in., that of the Pennsylvania station in Jersey City is 252 ft. 8 in., and that of the noted St. Pancras station in London is 243 ft., some idea of its comparative size may be formed. It shelters 16 tracks, and when extended, will be 800 ft. long.

The statistics of freight movement at Philadelphia would be even more impressive than those of the passenger service, but I am not able to give them complete.

During the month of January last, the records show the car movement for two of the lines to be as follows:

Main Line West—	Loaded.	Empty.	Total.
No. of cars arriving	23,190	693	23,883
No. of cars leaving	9,444	14,156	24,100
Totals	32.634	14,849	47,983
Schuylkill Valley Division—			
No. of cars arriving	5,635	265	5,900
No. of cars leaving	2,226	1,236	3,462
Totals	7,861	1,501	9,362

The total number of cars arriving and leaving over the above two divisions Feb. 7, 1903, was 2,431. These with the engines necessary to move them would form a train over two miles long.

All the Pennsylvania's roads at Philadelphia may be said to enter the city through West Philadelphia. This is true even of the New Jersey coast lines since they reach the Broad Street station over the Delaware River bridge and the tracks of the New York division. An enormous amount of business is therefore concentrated in West Philadelphia, and it is to facilitate the handling of this business, both passenger and freight, that improvements upon so large a scale in that section of the city have been planned. The principal objects it has been sought to accomplish may be stated as follows:

(1.) To provide for the safe and expeditious handling of incoming and outgoing passenger trains, by eliminating all crossings at grade of both tracks and streets.

(2.) To provide facilities for running passenger trains through between New York and Washington and between New York and the main line west (called the Philadelphia division), without taking them into the Broad Street station, as is done at the present time.

(3.) To provide better and more extensive facilities for handling through and local freight.

(4.) To provide facilities for handling the large amount of coal used in the city and supplied to vessels, and, incidentally, to provide for the rapid transit of fast or perishable freight through the city.

We can only briefly describe in a general way, in this article, the methods by which these results are to be secured.

At present nearly all the passenger trains entering Philadelphia go to the Broad Street station. Until very recently all these trains used a single three-track bridge over the Schuylkill River just above Market street. The main shops, roundhouses, and storage yard for passenger cars being on the west side of the river not only all schedule trains, but all the empty trains to and from the storage yard and shops, must cross this bridge, which has for many years been over-crowded. A second double track bridge was therefore built just above and nearly paralliel to the first bridge and this is now, and will continue to be used for trains of the Philadelphia, Baltimore & Washington Railroad. This new bridge is a through truss structure with two spans of 160 ft., one span of 153 ft. and one of 61 ft. It was completed and put in service Aug. 1, 1902. To provide still greater bridge capacity, and particularly to accommodate the trains of the New York and the Philadelphia division, a third double-track bridge has been built just below the original bridge. It is a deck truss bridge with two spans of 160 ft. each, one span of 150 ft. and one of 85 ft. From the west end of this bridge a steel viaduct 730 ft. long carries its tracks over the freight tracks and yards on the bank of the river. The whole structure is just about completed. The east end of all three bridges lead into the main line of tracks to the Broad Street station on the east side of the river, but each of the new bridges diverges somewhat from the line of the old bridge in a fan-like formation. The old or central bridge is to be used hereafter exclusively for empty trains and engines in transit from the shops and storage yards to the Broad Street station.

A commodious passenger station, now approaching completion, is being erected at 32nd street and Market street. The location of this station is shown on Fig. 3, and further details, with the arrangement of tracks about it are shown by Fig. 4. It is a two-story structure to accommodate the two sets of tracks on different levels which it is to serve. The general arrangement of these tracks may be traced on Fig. 3, remembering that each line represents a double track. P., B. & W. trains en route to or from Broad Street station cross the upper bridge over the river, and following the lower level, curve to the south, and passing first through a tunnel, 163 ft.

*Continued from page 180.

long, then through an open, walled cut 440 ft. long and 50 ft. wide, then by a covered cut 95 ft. long, reach the lower level of the 32nd Street station. Over the tunnel and the open cut, the tracks from the middle bridge to the storage yards and shops as well as various connecting tracks, are carried. Passing the station the P., B. & W. tracks enter a tunnel along and under 32nd street. This tunnel begins at the north line of Market street and extends southward for a distance 750 ft. The tracks then proceed toward Washington.

Trains to and from Broad Street station over both the Philadelphia and the New York divisions will cross the lower or southerly bridge over the river, and will approach the new station on a rising grade passing over the tracks of the P., B. & W. as described above, and will be served by the upper floor of the station.

In order that trains of the New York division may reach the tracks of the P., B. & W. road at this station they will be switched from the main line to New York at some distance northward, as will be described later, and, dropping below the main lines will cross under them through a tunnel or arched way and connect with the P., B. & W. tracks at the station. Over these connecting tracks through fast trains between Washington and New York will pass without going to the Broad Street station, passengers for Philadelphia being landed at the 32nd Street station, whence they can reach the Broad Street station by local trains.

The 32nd Street station is an artistic stone structure with extensive train sheds and shelters. The arrangement of tracks gives it a great train capacity, as eight trains may be served at the same time. It has been carefully designed and is very complete in all its details. Separate platforms are provided for inbound and for outbound passengers. The platforms for its lower tracks extend into the arched or covered tunnels through which pass the lower tracks. Commodious stairways connect the two levels, and passenger elevators and baggage lifts are also provided. A covered walk extends to Market street and a commodious cab stand is provided.

Fig. 4 shows the plan of this station and of the tracks about it. The cost of the station and its appurtenances will be about $125,000.

It is difficult, in a brief description, to convey an adequate idea of the improvements in progress in the West Philadelphia yards. Simple and complete as will be the whole arrangement for operating purposes, it is structurally so extensive and complicated as to impress the unfamiliar student as a gigantic Chinese puzzle. Perhaps we may best obtain some idea of it by following each set of main line passenger tracks from the 32nd Street station to its emergence from the labyrinth, and then describing briefly the arrangement of tracks for the freight service. Fig. 3 will assist in following this programme, bearing in mind that each line on the sketch represents a double track.

The main line tracks, four in number, of the New York division and the Philadelphia division (which later are used here also by the trains of the Schuylkill Valley division), leading to and from the Broad Street station, are on the higher level at the 32nd Street station and their arrangement at that station is shown by Fig. 4.

It will be observed that the inbound and the outbound tracks of the Philadelphia division are the inner and outer of the four tracks, the two tracks of the New York division being between them. From this station the four tracks run almost parallel with each other to 34th street. In this vicinity the tracks spread further apart, the New York tracks dip downward and, curving to the right, pass under the outbound track of the Philadelphia division, through a tunnel 550 ft. long. The tunnel is preceded by a walled open cut about 500 ft. long. Emerging from the tunnel the tracks continue to curve to the right around the Zoological Gardens, and proceed toward New York, with connections to be later described.

At a point about 4,000 ft. west of the 32nd Street station the tracks connecting the New York division with the P., B. & W. diverge from the New York tracks just described, which at this point are a sufficient distance apart to allow these connecting tracks to be located between them. The connecting tracks at once begin descending southward on a grade of 74 ft. per mile, and at a point nearly in the line of Mt. Vernon street enter a walled cut which extends for a distance of 1,750 ft. At the south end of this cut they have dropped sufficiently below the plane of the main lines to permit them to pass under the outbound main line tracks through a tunnel 400 ft. long, where they enter another walled cut 785 ft. long north of the main lines. At the end of this cut they enter the tunnel, 305 ft. long, at the 32nd Street station, previously described, and are led into the main line tracks of the P., B. & W. at the station. These depressed connecting tracks are also provided with connections with both the inbound and outbound tracks of the Philadelphia division so that trains between Pittsburg and Washington may avoid going into the Broad Street station.

The two main line tracks of the Philadelphia division, after parting company with the New York tracks continue westward on a rising grade and at the same elevation until a point just west of the crossing of Belmont avenue, after which the outbound track begins to rise above the inbound with an ascending grade of 1.5 per cent., so that when the 52nd Street station is reached, it is on the level of the third floor of the station, at a height of 35 ft. above the grade of the street. This track is supported upon an embankment between masonry walls for a distance of 2,170 ft.—the walls gradually rising in height westward—and then upon a viaduct constructed with masonry piers and plate girders of 35 ft. span, 1,750 ft. long, ending at the east end of a through truss bridge with a span of 385 ft., after crossing which the tracks reach the natural surface of the ground over an embankment. The freight tracks connecting the receiving and the classification yards of the Philadelphia division pass under this bridge.

The inbound Philadelphia division track is parallel to the outbound, but with a lighter ascending grade, so that when the 52nd Street station is reached, the grades of the two tracks are separated by a vertical distance of 24.6 ft., and it is served by the second floor of the station. It is carried for a distance of 700 ft. east of that street upon an embankment supported by a masonry retaining wall. Westward from the 52nd Street station, the outbound and inbound tracks begin to diverge so that the receiving freight yard mentioned hereafter may be located between them.

The main line tracks of the Schuylkill Valley division use the main line tracks of the Philadelphia division from the 52nd Street station into the city, and the connections between the two divisions are arranged as follows: The Schuylkill Valley tracks approach the Philadelphia division tracks almost at right angles, from the north, on a line that would cross the outbound Philadelphia division track about 500 ft. west of the 52nd Street station.

The outbound Schuylkill Valley track switches off to the right from the outbound Philadelphia division track just west of the west end of the bridge described above. The inbound track is depressed by a grade of 3½ per cent., so that it passes through a tunnel 325 ft. long under both the outbound and the inbound Philadelphia division tracks as well as the freight tracks connecting the receiving and the classification yards, and turning to the left on a rather sharp curve, switches into the inbound Philadelphia division track east of the 52nd Street station.

It remains to describe the connections between the New York division tracks and the Philadelphia division tracks which enable passenger trains to be run through between the West and New York without going to either the 32nd Street or the Broad Street stations. These connecting tracks switch off from the Philadelphia division tracks at a point about 4,500 ft. east of the 52nd Street station, near the crossing of Belmont avenue, and descend eastward on a grade of 1½ per cent. through a walled cut 1,670 ft. long between the Philadelphia division tracks, and curving to the north, pass under the outbound track of the Philadelphia division through a tunnel 1,000 ft. long, the western end of which is about 150 ft. west of the 40th street crossing. Emerging from this tunnel, the tracks are carried through a walled cut about 600 ft. long toward the main line tracks of the New York division. But if the junction of these connecting tracks with the New York division main tracks were made with all the tracks on the same plane it is evident that there would be a crossing of one track at grade. To avoid this, the inbound main track of the New York division, which is the extreme right-hand track approaching Philadelphia, is swung outward and depressed until it can be passed under the connecting tracks just described, as well as the freight tracks, through a tunnel 485 ft. long. The situation at this point is still further complicated by the fact that a double-track connection with the Philadelphia & Reading must be taken care of. These tracks are carried through a tunnel 390 ft. long, located alongside of and nearly parallel to the tunnel last described, and these junction tracks, as they are called, are then carried to a connection with the freight and yard tracks of the Pennsylvania Railroad.

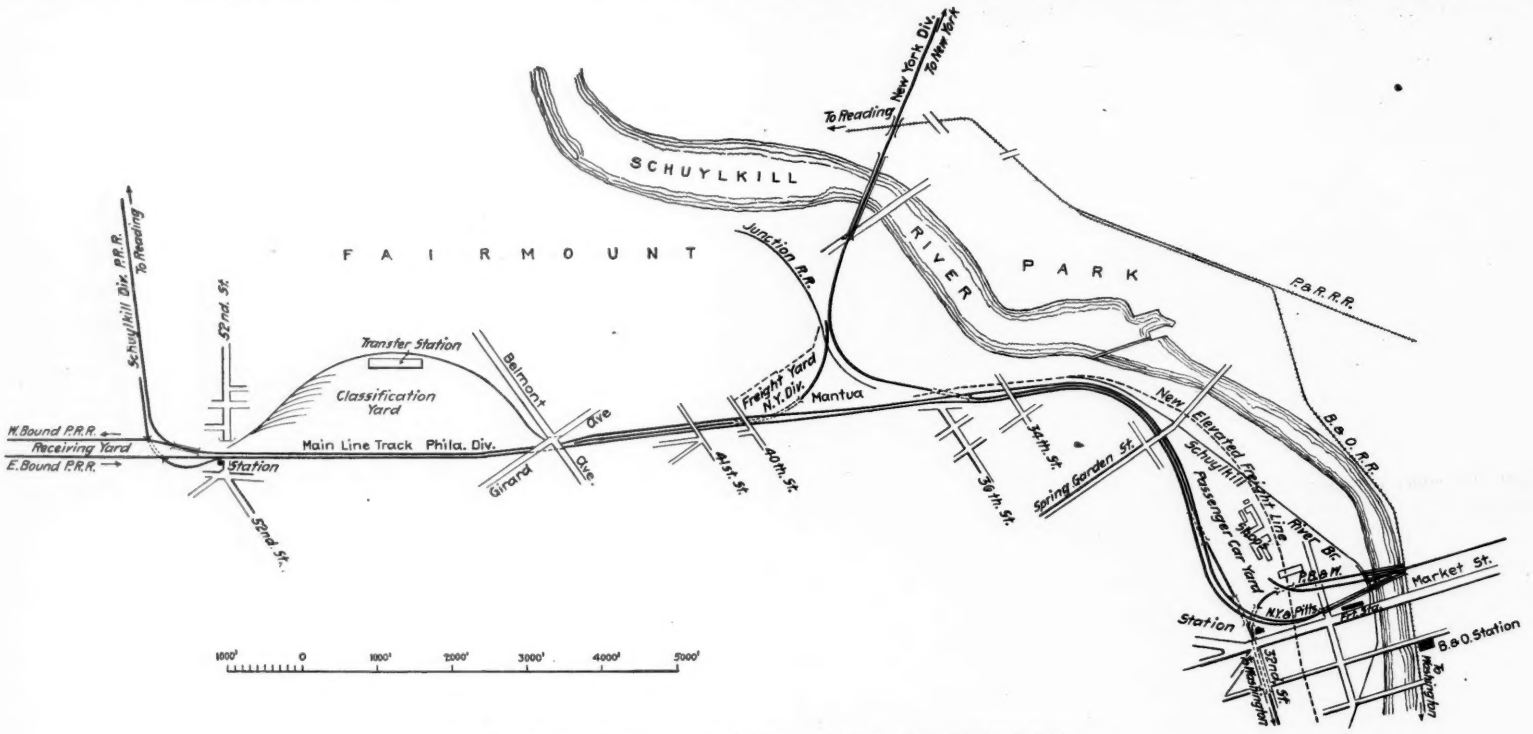


Fig. 3.—General Arrangement of Passenger Tracks, West Philadelphia.

If the above description has been made clear, it will be seen that as a result of the arrangement of the tracks, passenger trains, either in or out, on the New York division, the Philadelphia division and the Schuylkill Valley division can proceed to or from either the Broad Street station or the 32nd Street station, and the tracks of any division connected with those of either of the other two, without a single crossing of passenger tracks at grade; and as will appear later, without crossing a single freight or yard track at grade. Considering all the complications that exist and the great number of tracks that it was necessary to deal with this is a most remarkable result, and one cannot but admire the genius and skill of the engineer who worked it out.

The 52nd Street passenger station, which has been mentioned above, merits a passing notice. It is a three-story structure. The first floor is upon the level of 52nd street. There are no passenger tracks on this level. The second floor is at the level of the inbound tracks of the Philadelphia and the Schuylkill Valley divisions, and the third floor is at the level of the outbound tracks of the same divisions. Each floor is provided with ample platforms, waiting rooms and all usual station conveniences; and the floors are connected by ample stairways, passenger elevators and baggage lifts.

It is hardly possible to give a satisfactory description of the arrangement for handling freight trains in the West Philadelphia yards without going into details that cannot be attempted in this article. The very large area of property owned by the Pennsylvania Railroad is literally crowded with tracks, and their arrangement in all their details has been worked out with the same care and skill as that of the passenger tracks.

The freight business of the Philadelphia division—the main line to Harrisburg and the West—is of enormous volume and requires a vast amount of yard and track room. West of the 52nd Street station there has been

laid out and constructed a receiving yard about 3,000 ft. long, and 200 ft. wide, between the inbound and outbound main line passenger tracks. At its eastern end the level of this yard is sufficiently below the grade of the passenger tracks to allow the tracks connecting this yard with the classification yard, to pass under the bridge west of the 52nd Street station, and at the same time to cross 52nd street over the grade of the street.

The great classification yard, lying between the main line passenger tracks and Fairmount Park, has a length of about 4,000 ft. and a width of over 1,200 ft., covering an area of some 85 acres. It embraces a large transfer station, roundhouse, coaling station and other necessary appurtenances. This yard as well as the tracks to the receiving yard is designed to be operated by gravity.

The freight yard of the New York division lies in a space north of the main lines and west of the passenger train tracks connecting the New York division with the Philadelphia division west, and is connected with the classification yard of the Philadelphia division by a large number of tracks. It is as large and as advantageously arranged as the space available will permit.

The yards described are but a small part of the freight trackage in West Philadelphia, as every available bit of space for a distance of 3½ miles out from the 32nd Street station is now or will be closely occupied. The yard for storage of passenger trains and cars, located directly north of the 32nd Street passenger station and alongside the West Philadelphia shops is of large capacity and admirably arranged. It is connected directly with the three tracks of the middle or old bridge.

One of the most important improvements at Philadelphia is a new elevated double-track freight line connecting the West Philadelphia freight yards with the great coal piers at Greenwich. This line begins near 36th street, with connections to the Philadelphia division classification yard, and to the freight tracks of the New York division. Continuing southward it begins to rise above the general level of the adjoining tracks, passes under the 34th street highway bridge, but attains a sufficient elevation to pass by an elevated steel structure over the Spring Garden Street bridge, and thence, curving southward, and passing over the roofs of the shops and over all the main passenger lines, crosses Market street just east of the 32nd Street station at an elevation of 42 ft. above the street and continues southward to the "Arsenal Bridge" over the Schuylkill River. Thence it will follow the existing tracks to Greenwich. The elevated structure will be 7,000 ft. long, ending at South street. It is of the ordinary steel viaduct type, but stone piers and deck plate-girders are used at the street crossings. Just before reaching the Arsenal bridge connecting tracks lead to a junction with the freight tracks of the P., B. & W. main line. This connection with the P., B. & W. road is a very important one, as will be explained later. The cost of this new Greenwich line will be about $2,000,000.

The great new coal pier at Greenwich is 735 ft. long and has a capacity for a very large quantity of coal. The arrangements for handling and delivering the coal to it are very complete and interesting. Loaded coal trains arriving over the new Greenwich line are delivered to a special set of five tracks about 600 ft. long. These tracks have a descending grade of 1 per cent. toward the pier, and all lead into the single inclined track up which the cars are elevated to the top of the pier. Cars to be unloaded on the pier are dropped by gravity to the foot of the incline up which they are then hauled by a wire rope actuated by a stationary steam engine. The grade of this incline, is 17½ per cent., and its crest is 75 ft. above mean high water. From this summit the tracks descend on a grade of 1 per cent. to the outward end of the pier, where they are 65 ft. above high water, so that a car, when detached from the cable, runs by gravity, first into one of three tracks for temporary storage, and then out upon the pier.

There are two discharging tracks, 50 ft. apart, center to center, upon the pier. Between them is located the single return track for empty cars. The car is stopped and unloaded at any point upon the pier, and then dropped by gravity to the outer end of the pier, where it is switched into the central "empty" track. This track descends with a uniform grade of 1.54 per cent., passing under the incoming track near the inner end of the pier, and continuing to a junction with the storage yard for empty cars. Thus, with the exception of hauling them up the inclined plane, the cars are handled entirely by gravity.

The elevation of the storage bins of the pier is such that vessels laying alongside may be coaled by gravity. The cost of the pier and its adjuncts has been $316,000.

The elevated Greenwich line is intended to be used almost exclusively for two important purposes. One of these is the delivery of coal to Greenwich. The other is the unobstructed and rapid transit through Philadelphia, of fruit, vegetables and other perishable freight, en route from the South to New York. "Berry trains" (the railroad vernacular for this class of freight) will be switched from the P., B. & W. to and over this elevated route to the tracks of the New York division, and on to New York, practically without a stop in Philadelphia, and the time in transit for this class of freights will thus be materially shortened.

This description of the improvements at Philadelphia is necessarily inadequate. Some idea of their magnitude may be gained when it is stated that their estimated cost when completed is over four and one-half million dollars.

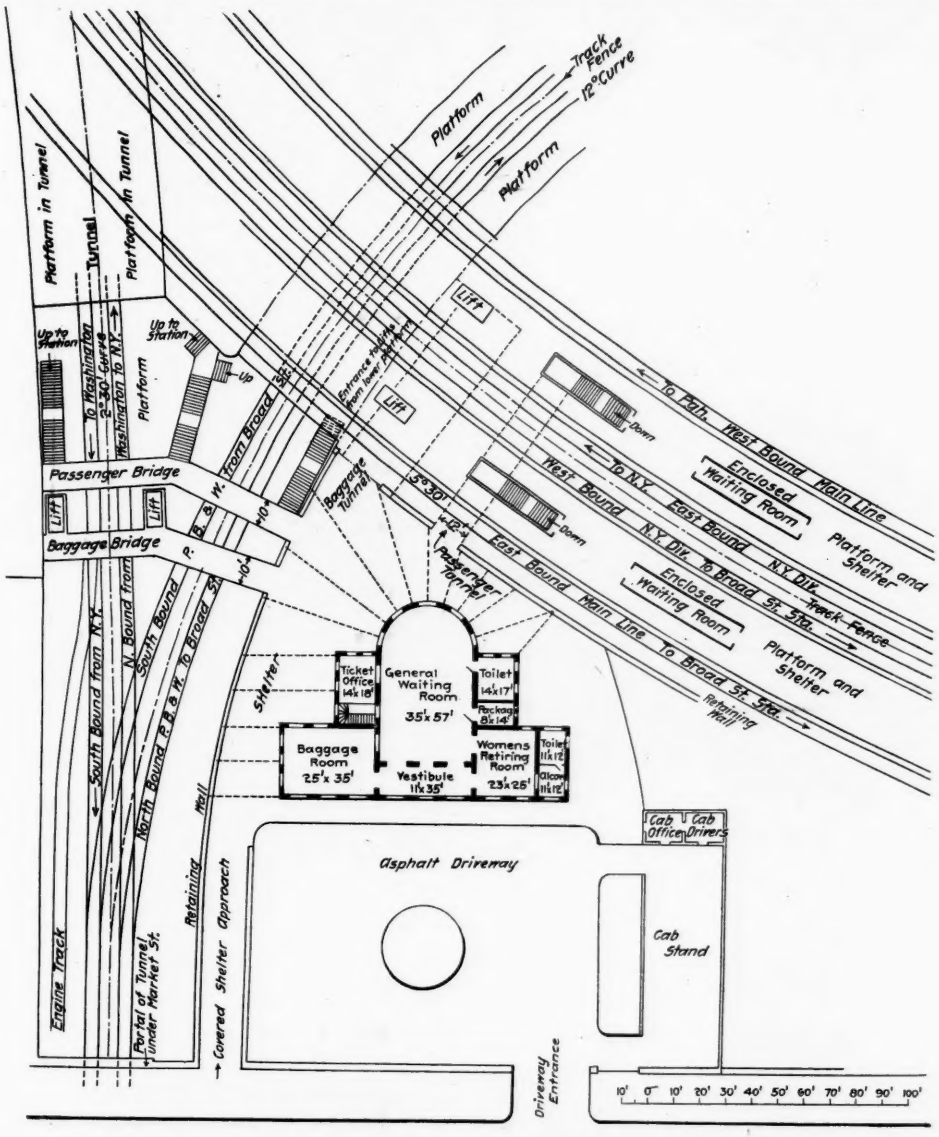


Fig. 4.—Arrangement of Tracks at Thirty-second Street Station—West Philadelphia.

Philadelphia to New York.

The principal work that has recently occupied and continues to occupy the attention of the management on the lines between Philadelphia and New York is the elevation of tracks through the several cities, and work incidental thereto.

Proceeding north from Philadelphia the first important improvement is found at Frankford Junction, where the location of the main line is to be materially changed to reduce grades and to secure easier curvature. On the present line the grade against southbound traffic is 31.7 ft. per mile, and this is accentuated by a 4½ deg. curve, making it the controlling grade between Philadelphia and New York. The change to be made will be something over two miles in length, the grade will be reduced to 21 ft. per mile, and the degree of curvature to 19 min. Owing to the great value of property through which the new line will run, it will be a very expensive improvement. The estimated cost, including an elevated connection with the Delaware Bridge track to the Jersey seacoast resorts, is about one and a quarter million dollars. This improvement will be completed by the end of this year.

The next important improvement is at Bristol, Pa., where the tracks are to be elevated to avoid grade crossings, and the location changed for a distance of slightly over two and one-half miles. The new line will be about one-fourth mile shorter than the present line, and will have 49 deg. of curvature of 40 to 45 min. curve, while the old line has 107 deg. of curvature varying from 20 min. up to 1 deg. 40 min. curve. The work is in progress and will be completed this year. The total cost of the improvement will be about $600,000.

At Trenton, N. J., an important change of route is now being made for the purpose of straightening the line, throwing out some objectional curvature and elevating the tracks through Morrisville and Trenton. The length of line changed is about 10,000 ft., but the track elevation extends over a considerably greater distance, to avoid eight street grade crossings. The most notable feature of this improvement is the new stone arch bridge over the Delaware on the new line. The total length of this bridge is 1,220 ft., and the elevation of the tracks above mean low water is 40 ft. The bridge consists of 18 arches of stone masonry, each arch having a clear span of 60 ft. The width under the parapet is 54 ft., and the bridge will carry four tracks.

The Trenton cut-off, which connects with the main line just south of Morrisville, must also be elevated at its junction with the main line. The cost of this work at Trenton will be about $600,000, and it will be completed in July, this year.

The next important improvement in progress is at New Brunswick, where the tracks are being elevated from 16 to 22 ft. through the city to avoid all street crossings at grade, and a new stone arch bridge is being constructed over the Raritan River. The elevation begins about two miles south of the south abutment of the Raritan River bridge, and extends to a distance of three miles north of that point before joining the old grade line, a total length of about five miles. The alinement is not changed. The new bridge over the Raritan River, and the manner in which it is being erected upon the same line as the old truss bridge, presents many points of engineering interest. The total length of the new bridge extending over the river, the Delaware & Raritan Canal and over Water and Neilson streets, is 1,455 ft. Beginning at its north end there are 10 arches of 66 ft. clear span, then two arches of 56 ft. span followed by eight arches of 51 ft. span, and finally one ribbed skew arch of 72 ft. span, over Neilson street. This last is a segmental circular arch with a radius of 39 ft., and a rise of 24 ft. All the others are plain semi-circular arches. The piers are founded upon rock throughout, the bottom of the masonry in the river being 65 ft. below the crown of the arch (intrados) and about 73 ft. below base of rail of the new tracks. The bridge is 55 ft. wide under the parapet and is intended to carry four tracks.

The general plan of the track elevation through the city is to build masonry retaining walls on each side of the road, and to fill the space between the walls with earth to the proper grade. At the street crossings stone abutments joined to the retaining walls are built on each side of the street, and plate girders are used to carry the tracks over the street. This work will be completed this year and its cost will be about $1,500,000.

Arrangements are being made to elevate the tracks through the town of Rahway and the work will begin as soon as the necessary authority is granted by the municipality. The change of grade will be about 6,000 ft. long, and 21 street crossings at grade will be avoided.

The work of elevating the tracks through Newark and its suburb, Harrison, is now in progress and will be completed during this year. The total length of this track elevation will be two and eight-tenths miles, and as a result no less than 23 street crossings at grade will be eliminated. The character of the work is similar to that at New Brunswick, but some special difficulties are met with and the work is more expensive. The elevation of the tracks through Elizabeth and through Jersey City was completed some years since, and when the work is completed in all the cities referred to above, all grade crossings in every considerable town between Philadelphia and New York will have been eliminated.

The effect of these improvements upon the economy and safety of operation and upon the speed attainable will undoubtedly be very marked. It should be possible to shorten materially the already fast time made by through

trains between the two cities. When all the work in progress and projected is completed the road between New York and Philadelphia will have no equal in America if in the world. With no curves exceeding 2 deg., and the total amount of curvature reduced to a minimum, with maximum grades of 21 ft. per mile, with four passenger tracks throughout, of the best modern construction and supplied with the most approved appurtenances, and with a signal system as nearly perfect as human ingenuity and skill can devise, the line may be accepted as a model of the most advanced railroad practice of the age.

Improvements at New York.

If the magnitude and importance of the improvements we have noted between Pittsburg and New York impress one as stupendous, no word short of colossal will fitly characterize those now under way and projected in the vicinity of the last named city.

New York is becoming every day, in a larger sense, the Commercial Metropolis of America. Recognizing this and forecasting the demands that the wonderful growth of the city will, in the near future, make upon the transportation capacity of all the railroads entering it, the Pennsylvania Railroad Company is preparing, in its broad-minded and courageous way, to meet them. The problems it finds itself called upon to solve are peculiarly difficult. Its present terminus at Jersey City is separated from New York by a wide and deep river, or arm of the sea, across which all its New York business, both passenger and freight, must be handled by boats.

The number of passengers carried daily by the road between Philadelphia and Jersey City is very great, and in addition to this through travel, the road does a very large commutation business between New York and the cities and suburban towns along its lines in the vicinity of New York.

The disadvantage and expense attending the transfer of all this business from Jersey City to New York by ferry boats is very great, particularly when it is remembered that a considerable part of it originates in or goes to Brooklyn, now a city having a population of over 1,000,000, and separated from New York proper by another channel of the sea. The company evidently realizes that the problem of handling this great passenger business satisfactorily requires heroic treatment. It has, therefore, projected and is about to begin the construction of a great tunnel which will pass under the North River, under Manhattan Island and under the East River to Long Island. The route of this tunnel and its connections will be substantially as follows: The double-track elevated road leading to the tunnel will leave the present main line about one mile east of Newark, and run thence north of east to the foot of Bergen Hill in West Hoboken. Here the double-track tunnel will begin, passing under Bergen Hill, Weehawken and the North River in the general line of 32d street, New York, produced; it will follow the line of 32d street under New York continuing under the East River and under Long Island City until it emerges and connects with the Long Island Railroad near Thompson avenue in that city. The whole length of the tunnel will be in the neighborhood of 5¾ miles.

An additional parallel double-track tunnel is provided for over the whole route, and a third one from the New York passenger station to Long Island City is contemplated. Upon the line of the tunnel in New York there will be constructed the largest passenger station in the world, occupying the space between 31st and 32nd streets and Seventh avenue and Ninth avenue. These tunnels are intended to be used primarily, if not exclusively, for passenger business, and they will probably be operated by electricity.

While the general plans of this gigantic enterprise are determined upon, the details have not been entirely worked out and no accurate estimates of the probable cost have been made public. The first tunnel is to be completed within five years.

The object of this great tunnel is not alone, however, for the accommodation of local New York business. The geographical location of the Pennsylvania Railroad and its terminal in Jersey City is not at present favorable to a satisfactory connection with the New England Railroad System, involving, as it does, a ferry transfer at New York. Through train service between New England points and the west via New York and the Pennsylvania Railroad is not possible except to a limited extent by cars transferred between the present terminals by boats.

It is therefore contemplated, in conjunction with the tunnel system under New York, to build a connecting line between the Long Island Railroad and the New York, New Haven & Hartford system, thus providing an all rail connection for this class of business. The details of this project are not yet available for publication.

The two improvements referred to have for their object the accommodation of the passenger business at New York. The handling of the freight business is to be provided for upon an equally broad and liberal basis. It is probably unknown to more than a few New Yorkers, that a work of very great magnitude has been for some time in progress at their very doors, which is nothing less than the reclaiming of a large area of submerged land in New York Bay to be used for the construction of freight yards for the Pennsylvania Railroad.

The company secured control, some years since, of a large tract of submerged land on the New Jersey shore opposite Greenville, about three and one-half miles south of its Jersey City station. This tract has a frontage on the present shore line of 3,600 ft., and extends out to the established pier line, a distance of about 9,500 ft., or 1.8 miles, its width along the pier line being 1,900 ft. The distance between pier line and bulkhead line is here 4,400 ft., admitting of the construction of piers of more than four-fifths of a mile in length. The area of the whole submerged tract acquired by the company is about 550 acres, and the area of that part of it between the bulkhead line and the present shore line is about 340 acres.

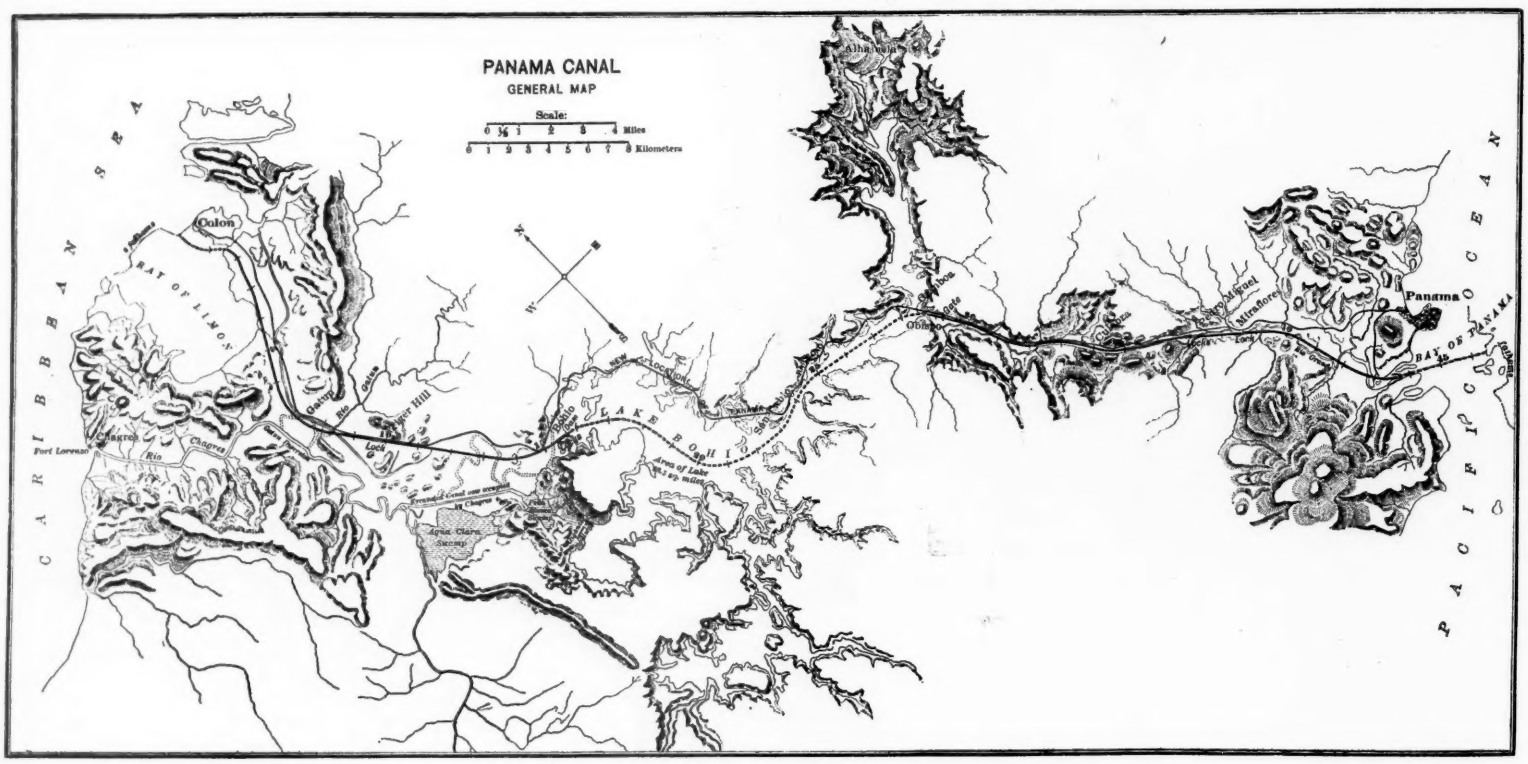
The company has been engaged for some time in dredging channels and in filling in that portion inside the bulkhead line. About 8,000,000 cu. yds. of filling will be required in all, of which about three-quarters has been put in place. The material excavated from the great tunnel under New York will be deposited here, and plans for transporting and handling this material are being worked out. The company has also acquired a strip of land 400 ft. wide extending from the above described tract entirely across the peninsula to Newark Bay, a distance of nearly one mile. Right of way is also secured for the extension of the New York Bay R. R. from the main lines across Newark Bay to the above described property.

Upon the property described will be constructed freight yards and piers of very large capacity. The strip between Newark Bay and the present shore line of New York Bay will be utilized for a receiving yard, and upon the reclaimed land west of the bulkhead line will be laid out and built a vast classification yard. From the bulkhead line will be built out five great piers, one of which will be used for warehouses, one for export grain business, with a grain elevator at its outer end, and the three others for coal and other freight. There will also be a special commodious pier for car floats, from which cars will be distributed by transfer boats to various points in New York city, or transferred to the Long Island Railroad, and to New England points via the New York, New Haven & Hartford road. The Bay Ridge terminal of the Long Island Railroad will be directly across New York Bay, and but two and a half miles from these piers, and the conditions for transferring cars between these points will be unusually favorable.

I have attempted in this article to sketch briefly the improvements on the main line from Pittsburg to New York only. Prodigious as may seem the scope and magnitude of the work in hand upon this part of the system, it is but a part of the total betterments that are engaging the energies and capital of the company upon the whole system under its control. Improvements upon the other lines and branch lines of the system are being projected and carried out upon the same broad and liberal scale, in order to meet the growing demands of their business.

The keynote to the whole policy of the management seems to be that in serving the public best it will best serve its own interests. President Cassatt voices this policy in his annual report when he says: "The duty which your company owes to the public, as well as to the shareholders, clearly requires that your lines should be put in a condition to supply the legitimate demands of your shippers."

(TO BE CONTINUED.)



The Panama Canal.

(From Mr. George S. Morison's paper in the January, 1903, Proceedings of the American Society of Civil Engineers.)

The Panama Canal Treaty.

The Panama Canal Treaty between the United States and Colombia was ratified by the United States Senate March 17, with only five negative votes. It was signed at Washington on Jan. 22, 1903. It was negotiated by Secretary Hay on the part of the United States and Thomas Herran, Charge d'Affaires, on the part of Colombia. Neither in committee nor by the Senate was the treaty amended, and it was ratified as first negotiated. The treaty is yet to be ratified by the Colombian Government.

The treaty, as ratified, gives the United States exclusive right for 100 years, renewable at the option of the United States, to complete the Panama Canal, maintain, protect and operate it.

Also gives to the United States "the use and control of a zone of territory three miles wide on each side of the canal. The United States recognizes the sovereignty of Colombia over the Isthmus. Colombia agrees not to cede or lease naval stations or military posts within the Department of Panama to any foreign government.

The treaty relieves the canal from taxes of any kind, permits immigration of workmen, authorizes the United States to preserve order and discipline on the canal and railroad, declares the canal neutral in perpetuity, gives Colombia the right of free transportation of its vessels, wipes out all anterior concessions, and transfers to the United States Colombia's interest in the new Panama Canal Company and in the Panama Railroad.

Colombia agrees to provide armed forces for the protection of the canal, if necessary. In the event of her inability to do so, the United States is authorized to employ such forces as may be necessary.

The United States agrees to begin the main work within two years and to open the canal for passage within 14 years. For the rights and privileges secured by the treaty the United States agrees to pay Colombia $10,000,000 in gold when ratifications of the treaty are exchanged, and $250,000 annually after the first nine years.

Under the contract drawn between Attorney General Knox and the Panama Canal Company the latter will receive $40,000,000 in a lump sum upon the exchange of ratifications.

It is said that President Roosevelt will not appoint the members of the Canal Commission until after ratification by Colombia.

The Maintenance of Way Convention.

The fourth annual convention of the American Railway Engineering and Maintenance of Way Association was held at the Auditorium Hotel, Chicago, March 17, 18 and 19, the attendance being about 130. It was the original purpose of the Association to get through in two days, but a Thursday morning session was found to be necessary.

The President of the Association, Mr. G. W. Kittredge, of the Cleveland, Cincinnati, Chicago & St. Louis, called the meeting to order at 9.35 o'clock on Tuesday morning. In opening, Mr. Kittredge made an address congratulating the members on the success of the Association and on the systematic character of the committee reports.

The Secretary and Treasurer reported that the receipts during the year were $6,553, and the expenditures $5,152, leaving a balance of $1,401. The membership at the time of the last meeting was 406; present membership, 454. During the past year the following members have died: Augustus Torrey, Chief Engineer, Michigan Central, member of the Board of Diretcors and first Chairman of the Preliminary Organization; E. A. Kellogg, Assistant Superintendent, Chicago & North Western; George Montague, Superintendent of Bridges and Buildings, Sonora Railway.

Following are the officers elected for the ensuing year:

President—Hunter McDonald.

First Vice-President—H. G. Kelley.

Second Vice-President—James Dun.

Secretary—L. C. Fritch (re-elected).

Treasurer—W. S. Dawley (re-elected).

Directors to serve three years—A. W. Sullivan, G. W. Kittredge.

The Secretary, Mr. L. C. Fritch, through ill health has been obliged temporarily to give up the duties of his office. Mr. E. H. Fritch was appointed to act as Secretary during the ensuing year, or until the Secretary is able to resume his duties.

There was not time to consider all of the committee reports. Those not discussed were ordered printed in the Proceedings for written discussion during the year. Abstracts or excerpts of various reports, with the gist of the discussions on them, will be found in this issue.

One report, which does not appear, is that of the Committee on Compensation of Signal Pipe Lines. This report contains a drawing of a lazy-jack compensator and also diagrams of pipe lines with rules for making connections at compensators at different temperatures. There is a table showing variations in length to be observed in adjusting pipes at different temperatures from 10 deg. below zero to 110 deg. above.

Classification of Maintenance of Way Expenditures.*

The terms Improvements, Additions, Betterments, Extraordinary Expenses, Maintenance Account, Capital Expenditures, etc., are used to-day frequently without any absolute or uniform meaning. The effect of the determination and ultimate disposition in the general accounts of certain of these classes of expenditures is so far-reaching and affects the general financial results to such an extent that it would seem desirable to establish clear definitions and uniform practice.

Where expenses are not properly grouped, it is impossible to draw valuable conclusions as to the operating efficiency, to make comparisons, or to satisfactorily explain any unusual variations in expenses for any section of road or period. Without such grouping the irregular work and extra expenses, dependent on contingencies of all kinds occurring at any moment in railroading, will effectually block any attempt to readily ascertain correct unit costs of maintenance proper, to make comparisons and forecasts of practical value.

The following definitions are given in the paper to cover the various groups proposed for the proper classification of maintenance of way expenses.

The term "Repairs" to represent all expenses for the regular maintenance of the property is sub-divided to four sub-groups according to the following rules:

Current Repairs to consist of regular, constant, annually recurrent expenditures for repairs and sundry minor work, required regularly from year to year to maintain in an economical and efficient manner the physical condition of the property and keep the track and structures in shape and safe for operation, embracing all charges for superintendence, labor, materials and sundry items, in the nature of fixed expenses, regular forces, or customary material purchases, necessarily required for the regular maintenance of the property and the safety of the track and structures; provided, such charges are not in the nature of large expenditures incurred for unusual, unforeseen contingencies, for large special requirements not distinctly repair work or not uniform on all sections of a road, or for extensive non-annually recurrent repairs or renewals.

Contingent Repairs to consist of unusual, unforeseen expenditures due to severe storms, floods, fire, accidents and casualties of all kinds, necessitating expensive emergency work, and, in many cases, subsequent extensive repairs or renewals; provided, such work is not of such a comparatively small nature as to belong properly to the uniform and routine work of the regular maintenance of way forces, even if the expense is caused by an unforeseen contingency.

Special Repairs to consist of such minor items, necessarily permanently chargeable to maintenance account, even if not distinctly repair work, which items if charged to current repairs would tend to vitiate the comparative statistical value of the current repairs account, or which items are too small and the work too insignificant to warrant charging to extraordinary repairs or classing as a permanent improvement to the property.

Extraordinary Repairs to consist of large non-annually recurring repairs or extensive renewals in the nature of maintaining the property, provided such work does not constitute a betterment or addition.

Improvement; this term to represent all expenses which create a specific, permanent, physical improvement, tending to increase the value of the railroad property as a whole, in the form of a betterment or an addition to the property, sub-divided to two sub-groups according to the following rules:

Betterments to consist of any permanent betterments to the existing property and facilities, constituting an actual, distinct, positive, permanent, physical improvement, tending to increase the value of the railroad property as a whole, the charge to cover in all cases only the difference in cost of the new improved structure or facility and the estimated cost of replacing the old unimproved structure or facility; the term betterments to apply in general to work such as replacing bridges with a more permanent character of materials, strengthening bridges for increased loading, rebuilding buildings, structures, auxiliary appliances and facilities of various kinds on a larger scale and with a better class of materials, increase of track mileage due to rearrangement and remodeling of existing yards and track layouts, stone ballasting, etc.; provided, the work in question does not consist merely of extensive repairs or remodeling and changing of existing facilities producing no visible extension or important enlargement of such facilities.

Additions to consist of any permanent addition to the existing property and facilities, constituting a distinct, separate, new, permanent, physical improvement, tending to increase the value of the railroad property as a whole, such as new roadbed, tracks, bridges, buildings, structures, or other auxiliary appliances and fixtures, etc.; provided, such addition or improvement is not in the nature of repairing, renewing, replacing, changing or remodeling any existing facility.

*Synopsis of a report presented at the March convention of the American Railway Engineering and Maintenance of Way Assn., by Walter G. Berg, Chief Engineer of the Lehigh Valley Railroad.

Train-Order Signals.*

The replies to the Committee's questions on the subject of train-order signals disclose a good deal of cloudiness in the minds of members, due in part to the use of train-order signals for other purposes, and combining the functions of two or more signals into one, and calling it a train-order signal. This combined use is perfectly legitimate in some cases, and in other cases leads to confusion. A train-order signal naturally merges into a block signal, and it is often difficult to define the line between them. A circular was sent to 152 members, and answers were received from but 40. A train-order signal is not always a fixed signal under present practice; flags and hand lamps being used for that purpose by a large number of our members. Only one member seems to be using the old-style banner or revolving train-order signal, and it is fair to assume that it is gradually giving way to the semaphore pattern. He has already adopted the semaphore for double track.

Of the semaphore patterns which are now in use, the arms for both directions of traffic are generally placed on the same mast, and the lamp and mast centers coincide. Some members place the lamp on the side of the mast, but this leads to two different patterns of semaphore castings, which is not economical or convenient. . . . Even when a railroad has the necessary signal system for operating the trains under block signal rules, it becomes necessary at times to issue train orders, may be to give notice of a washout or wreck, or to order the use of one of the tracks in a reverse direction. To do this arrangements are now being made to put up special signals on the Eastern Division of the Pennsylvania Lines West of Pittsburgh.

Where block signal systems are used, when it becomes necessary to issue train orders, the attention of engineman and conductor is called by

(1.) Same signal as used for blocking on Chicago, Burlington & Quincy; Chicago & North Western; Lehigh Valley; Sante Fe; Southern Pacific, Delaware, Lackawanna & Western, and others.

(2.) Separate train-order signals on Central of New Jersey; Illinois Central; Michigan Central; Philadelphia & Reading.

(3.) A red or green flag or lantern on Baltimore & Ohio. (Where automatic blocks are used, train-order signals are also used, controlling first automatic distant signal blade in each direction.) Boston & Maine; Erie; Long Island; Pennsylvania Lines West of Pittsburgh.

When running on a track in the reverse direction, the engineman and conductor are notified of train orders by—

(1.) Regular train-order signals, where placed for both directions on one mast, on Chicago, Burlington & Quincy; Chicago & North Western; Delaware, Lackawanna & Western; Galveston, Harrisburg & San Antonio; Illinois Central; Lehigh Valley; Pennsylvania Lines West of Pittsburgh; Philadelphia & Reading; Southern Pacific, and others.

(2.) Red flags and hand lamps where train-order signals are placed alongside of track on separate masts, on Pennsylvania Lines West of Pittsburgh. . . .

It will be observed that in the case of double track, the regular train-order signals are used on most railroads for trains running in the reverse direction, and it may be considered good practice when the signal arms are on one mast, because this signal signals *trains* and not *tracks;* but the plan allows of no expansion, and has been known to cause accidents where three or four tracks merge into two. When the train-order signals are so located as to govern trains only on the tracks alongside of which they are placed, they should not be used for trains running on a track in the reverse direction. The train-order signal has not heretofore been located with the exactness required by interlocking signal rules, but it is now time to bring this signal into line and place it where it belongs. The fixed train-order signal should be of such design and so located that, when the railroad becomes of enough importance for block signals, the very same signal can be used in its next stage, the telegraph block signal, without throwing it away and getting another one of different design.

The American Railway Association's third and fourth requisites of installation of interlocking plants are: (3d)

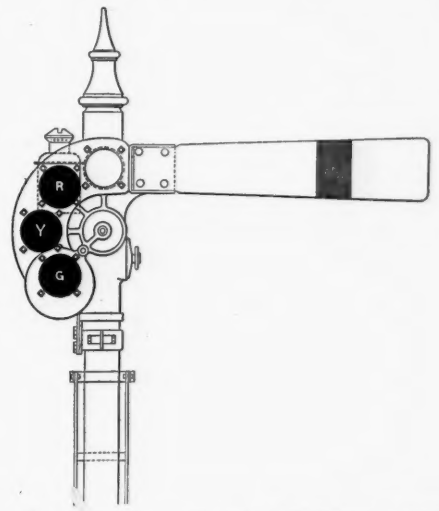


Fig. 13.—Proposed Standard Semaphore—American Railway E. & M. W. Association.

"Signals, if practicable (to be either over or upon the right of and adjoining the track to which they refer." (4th) "Semaphore arms that govern, (to be) displayed to the right of the signal mast as seen from an approaching train."

The first recommendation, therefore, of the Committee is that these two requisites be adopted with reference to fixed train-order signals for all numbers of tracks from one up.

The second recommendation is, that where it may be deemed advisable, for special reasons, to use a bracket mast, no more than two uprights be placed on the bracket. One of these uprights may be a stub to indicate a track not signaled. In other words, no more than one track should intervene between a bracket signal mast and the track for which its left upright carries the signal arm.

When a railroad has more than two main tracks, it is almost sure that it will be operated under block signal rules. Nevertheless, there are times when train orders or instructions must be issued. The methods in general use are: (1) Same signal as used for blocking; (2) separate train-order signals; and (3) the proper colored flags or hand lamps. So far as the first method is concerned, it is not logical, and does not mean "train orders," unless some special rule is formulated. In a block signal system the engineman and conductor should remain on the train till the "proceed" indication is given, unless, indeed, the delay is prolonged. If it is the intention to give them orders, they should know it as soon as the train reaches the telegraph office, or before. The second method is doubtless the logical and correct one. It seems to the Committee, therefore, that it is proper to indorse the practice of using flags by day and hand lamps by night, stop being for "31" orders, and caution for "19" orders. It is important, though, that a regular place for displaying these be predetermined, and there seems to be no better way than to place a regular flag socket with hook on the side of the signal station next to the approaching train, and convenient for the operator to reach from one of the windows.

The third recommendation of the Committee is the indorsement of the use of flags and hand lamps.

The fourth recommendation is the definition of "train-order signal" as follows: "A signal, fixed or otherwise, of two indications, which in the stop position informs the engineman and conductor that they are to receive orders at the telegraph office, and in the clear position announces that there are no orders for them."

A fixed train-order signal at the present time is a two-indication semaphore arm, having a sweep from horizontal to 60 deg., 75 deg. or 90 deg. Necessarily, the arm casting in each case is different. It is undoubtedly the best practice to have this range from horizontal to 90 deg., which is our fifth recommendation. The result of

*Extracts from the report of the Committee of the American Railway Engineering and Maintenance of Way Association, March, 1903.

the vote recently polled on that question in answer to our circular was 24 in favor of 90 deg. angle, eight in favor of 70 deg., and 23 in favor of 60 deg. . . .

. . . It is the will of the Association, as expressed by the recorded [majority] vote, to have a fixed train-order signal with a sweep of arm of 90 deg., and with a spectacle casting arranged on the "continuous-light" principle. The plan of such a signal is presented in Fig. 13, and it is recommended for adoption as the standard of the American Railway Engineering and Maintenance-of-Way Association, being the sixth recommendation of this report. It will be observed that the arm is so hung on the spindle that it can be placed in a vertical position and yet not be hidden by being in line with the post. The arrangement of the spectacles shown in the drawing is that for a three-position signal; red for stop, yellow for caution and green for all clear. The upper spectacle opening is blank. This upper opening would come into use in case the post were cut off and the lamp placed on top of it, as is done where an arm for trains moving in the opposite direction is placed on the other side of the post. It will be seen that the arm can readily be arranged to use red in both of the two upper spectacle openings, the two thus making substantially a "continuous light." For a two-position signal the upper opening can be left blank and the next two made red to provide the "continuous" effect.

This signal is suitable for either a train-order, or interlocking, or automatic block signal. It can be used for either two or three indications, and is suitable for those roads having red for "stop," green for "caution" and white for "proceed" or "no orders," or for those having red for "stop," yellow for "caution," and green for "proceed" or "no orders." Furthermore, it is adaptable for roads desiring to put two arms on one mast for both directions, because the top of the mast can then be made flat and the lamp placed thereon. The mast, as well as the signal arm and casting, is recommended for standard.

DISCUSSION.

The first recommendation was adopted.

Mr. Cushing (P., L., W. P.): Coming to the second recommendation, I have seen, in an attempt to follow out a bracket signal-mast principle, a signal mast with as many as eight or 10 stubs on it, which seems entirely unnecessary. A little rearrangement of the tracks will prevent such a confusing arrangement; such bracket masts are nothing but a mystery to a trainman. He does not know what they actually mean, and at high speed he cannot accurately count the stubs. The bracket mast should be restricted to two uprights.

The second recommendation was adopted.

Mr. W. G. Besler (Cent. of N. J.): I would like a little explanation of the third recommendation. The committee says that it is proper to indorse the practise of using flags by day and hand lamps by night, stop being for "31" orders, and caution for "19" orders. Why that recommendation?

Mr. Cushing: The "31" order is to be signed by both engineer and conductor, and no train can receive a "31" order without stopping. The "19" order is an extension of rights to a train, and is delivered to the engineer while the train is in motion by a hook or any other convenient apparatus for the purpose. Consequently, when a train is to receive an order of that kind, the operator simply displays a caution signal, and that indicates to the engineman that he must go slow enough to receive the order without stopping.

Mr. Besler: The American Railway Standard Code provides that the train order signal must be displayed when there are orders for the engineer, and the signal remain displayed until the full purpose is accomplished. That order is a red signal, and not a green signal; the caution signal for "19" orders is hardly permissible.

Mr. Cushing: The value of a "19" order is entirely lost if the train is stopped. Its object is to deliver a notice to the engineman that he has extended rights by reason of some other train falling back on rights previously given. Any stop signal means the train must come to a stop, and it is not a proper one to use for "19" orders.

Mr. Besler: The "19" order is used for the same purpose, and covers the same matters as the "31" order, as given by the American Railway Association. There is absolutely no difference.

Mr. Cushing: I know of railroads that are doing it, and that give a different value to these orders.

Mr. C. A. Paquette (Big Four): If the "19" order confers rights on the train, I cannot understand why "19" is the same as "31." I would like Mr. Besler to explain where he differentiates between "19" and "31." I do not understand why you use the "19" order at all under the system of operation which you describe. As a general rule, "19" confers rights, and "31" restricts them.

Mr. Besler: There is nothing in the book of rules which prevents the use of "19" for the same purpose as "31." It is very common to do so, however. Some roads elect to use the "31" form, thinking it is safer to do so, as it requires the signature of the engineer and conductor, or just the conductor. Other roads use the "31" only in exceptional cases, but the use of the "19" is becoming more and more general. There is nothing in the standard code that requires the use of the "19" for any particular form of order, or the "31" for any other particular form of order; it is optional with the despatches which one he shall use.

The Chairman: Have you any amendment to offer to this recommendation, Mr. Besler?

Mr. Besler: I move that the following words be stricken from the paragraph at the bottom of page 15 (second recommendation), in the second line, after the word "night" the words "stop being for '31' orders, and caution for '19' orders;" and in the third recommendation of the committee, strike out the words "and their display as explained in the preceding paragraph."

The Chairman: Does the committee accept the amendment?

Mr. Cushing: No. The Committee thinks this is good practice to recommend. It brings out the particular value of the "19" order. If trains stop to receive a "19" order, I do not see much good in it. It is of excellent service in cases where an order is hung out with a hook, from which it is taken by the engineer, and allows the train to proceed without stopping. It is not dangerous; it is perfectly safe practice. There is no use for anything more than the "31" order if all trains are to be required to stop for orders.

Mr. Besler: There is no cautionary train order signal. The words I asked to have stricken out are in favor of a cautionary train order signal. There is nothing of the kind in existence, nor do I believe that any railroad company would adopt anything of the kind. A train order is put out to help some train, just as has been suggested, and a "19" form is used so that the train may proceed without stopping for that order. The operator receives the order, repeats it as it should be, and with his signal displayed goes to the platform, and by whatever means he has at hand, delivers that train order. He then goes to his office and withdraws the signal if the full purpose of the order has been accomplished by its delivery to that one train. If there are other trains addressed in the order, he must keep the signal displayed. A clearance card is handed with the order given to the first engineer. In my opinion the recommendation is in direct opposition to the work of the American Railway Association. If we strike out these words, I do not know whether there would be any objection to adding the following: "To have a fixed place to hang lamps on or flags, is proper, and in accordance with good practice."

Mr. Besler's amendment was carried:

Mr. Cushing: The fifth recommendation is the sweep of the arm from horizontal to 90 deg. The object of the *final* (sixth) recommendation of the committee is that the association recognize as a signal casting one that may be turned into a block signal in the future; in good block-signal practice to-day there is as much permissive blocking as absolute. By the adoption of this one signal casting we can use the caution position in it when we turn it into the block signal. It is not the idea to use it with the permissive indication for train orders. It is, perhaps, quite necessary, however, to consider that in that connection we recommend a sweep of 90 deg., because if 60 deg. or 75 deg. is adopted as the proper sweep of the arm, when it comes to making that into a block signal in the future it practically means throwing away the signal casting and getting another one with the permissive, because there is no doubt many railroads will use permissive indication for a long time to come.

Mr. J. C. Mock (Mich. Cent.): It is intended to be a universal signal, block-signal, train-order signal and interlocking signal. As soon as a train-order signal becomes inadequate, it is time to dispense with the telegraph block. The idea of the committee is to get a signal which would be universally adopted and used for this purpose of train orders. Many roads have used the same signal for train orders and for the telegraphic block.

Mr. Cushing: The final portion of this recommendation is the adoption of the universal casting, which will take the place of the 75 now manufactured by one company alone, and it can be used in any way anyone sees fit, by changing the position of the glass.

Mr. W. H. Elliott (C., M. & S. P.): The 60-deg. sweep of the arm possesses one thing that is very essential in all good signaling, and that is that the indication is very distinctive; it can be more plainly seen than where the arm is parallel with the pole. The object stated by the committee in adopting the 90-deg. traveler is to have the arm interchangeable and used for all situations. This is a very desirable thing, but I do not think we should give up the distinctness of the arm for the sake of interchangeability. Other parts of the signal cannot be interchangeable, and there is practically but little saved by adopting interchangeability. The shaft has to be different for block signals where there are two castings on one shaft, and this shaft is not adapted for use at interlockings. Then, again, the casting for the 90-deg. sweep is a much heavier casting than the one for the 60-deg. sweep, and costs more. The cap of the casting must be different for the 60-deg. sweep from what it is for the 90. So, to have one part interchangeable, other parts cannot be interchangeable, or they are made much more expensive. Again, there is greater difficulty in moving the arm when the sweep is 90 deg. than when it is 60. There is 30 deg. more travel, and as the casting in each case is weighted about the same, the signalman does more work in one case than in the other. We find great difficulty in keeping our arms adjusted, and getting operators to pull them to the proper position, and with a 90-deg. travel this difficulty would be exaggerated.

Mr. Besler (Cent. of N. J.): I would like to make this motion as the fifth recommendation: "This association recommends as the best practice a fixed train-order signal, with a sweep of arm from the horizontal to 90 deg."—a combination of the two paragraphs recommended by the committee.

The motion was carried. Then, in order that the fourth recommendation should be in agreement with this, it was changed to read: "A fixed signal of two indications, which in stop position informs the engineman and conductor that they are to receive orders at the telegraph office, and in the proceed position announces that there are no orders for them."

The sixth recommendation was adopted without modification.

Concrete Masonry.*

Concrete being a mass of broken stone or gravel cemented together by a matrix, it follows that having selected the stone or gravel, it is necessary that the proper amount of matrix be determined; it would appear at first thought that if the voids in the stone or gravel mass be determined that the matrix necessary would be equal to the voids, but further consideration would indicate this to be irrational. If we can imagine a mass of concrete in which the voids are precisely filled, with no surplus matrix, it would necessarily require that the various constituent stones would be in actual contact, and as the planes of their surfaces are not at right angles to the line of pressure, we would have a mass of concrete full of minute incipient cracks. It therefore follows that there should be an excess of matrix to insure the entire surface of all the stone or gravel being covered with the cementing material. This film of cementing material should, however, be as thin as possible, and the excess of matrix be attained by an excess of cement above the voids in the sand; experience shows this should be from 5 per cent. to 10 per cent. of the voids.

Various writers recording experiments with broken stone and gravel place the voids at from 41 per cent. to 50 per cent. of the mass. A number of experiments with crushed blue limestone, well shaken but not rammed, conducted under the direction of the chairman of this committee, gave the following:

Size of broken stone.	Weight of 1 cu. ft.	Per cent. of voids.
Crusher run with dust screened out	89.222	45.16
Stone which passed 2-in. grating and retained in 1-in.	86.741	47.70
Stone which passed 2-in. grating and retained in ½-in.	77.701	50.66
Pea size	75.444	49.63

The sand has usually been required to be "sharp," but it is questionable whether a rounded grain would not give equally as good results, and the ideal sand be one containing grains of varying sizes without reference to their shape, thus reducing the voids to a minimum and requiring less cement to thoroughly cover the grains. Experiments show that with ordinary sand the voids will vary from 31 per cent. to 38 per cent.

Wm. B. Fuller, in the Transactions of the American Society of Civil Engineers, suggests that the sand should equal the actual voids in the stone and the cement be added possibly up to 10 per cent. in excess of the voids in the combined material. This proportion is probably theoretically correct, but it is necessary to bear in mind that, owing to the impracticability of securing perfect mixing in large masses, experience has shown the wisdom of increasing the actual volume of the mortar somewhat above the exact theoretical limits. If we take broken stone giving 47 per cent. of voids, and sand with 32.3 per cent. of voids, we will find the theoretical proportion to be: Cement 1, sand 3.1 and broken stone 6.5, as stated by S. B. Newberry in his article on concrete, in the Proceedings of the Indiana Engineering Society. If now we add 5 per cent. of cement and reduce to the basis of cement 1, we will have cement 1, sand 2.96, broken stone 6.2, or nearly the proportion quite generally used for concretes of 1, 3 and 6; this actual proportion giving an excess of mortar. The same reasoning can be applied to other mixtures and it will devolve upon the engineer to select for each individual piece of work the proper mixture to meet in the most economical manner the purposes required.

In all cases the necessity of thoroughly washing all dust from the stone and wetting it down cannot be too strongly impressed. Concrete as a construction material presented a high compressive strength with a low tensile strength, and to increase its economical application to various types of structures, the method of reinforcing with steel to secure tensile strength was a natural and gradual evolution, and this was simplified from the fact that the thermic expansion of concrete and steel is identical, and the tension modulus of elasticity of the reinforced concrete remains constant up to a stress which is equal to the rupture in case of concrete not reinforced.

M. Considere states that concrete when not reinforced will break with an elongation of less than 1 part in 10,000, yet he remarks the tension faces of a reinforced concrete beam support an elongation of more than 1 in 1,000, without sign of fissure. Prof. Hatt, in writing of this, says: "The excess of elongation over the ordinary concrete may be accounted for by supposing that the wire or other material reinforcement distributes an elongation throughout the entire length of the concrete: whereas the elongation when not reinforced is confined to the section of rupture."

Experiments of M. Hennibique, a French engineer, showed the adhesion between concrete and an iron rod imbedded in it to be from 570 to 650 lbs. per sq. in. of imbedded metal surface, and that a rod imbedded to a depth of 25 times its diameter would pull apart before separating from the concrete.

*Extracts from the report of the Committee of the American Railway Engineering and Maintenance of Way Association, March, 1903.

Experiments conducted by Mr. Robt. Moore at the time of construction of the St. Louis Merchants Bridge Terminal Railway upon anchor bolts imbedded in Portland cement and allowed to stand for 10 days, gave a resistance of 500 lbs. per sq. in. of imbedded surface before pulling apart or loosening.

It follows from the above that there is an economical ratio between the sectional area of the reinforcing bars and the adhesion to their superficial area, and it will be found that this economical ratio calls for small sections of bars with large superficial area, rather than bars of large section with small superficial area.

In presenting the accompanying specifications for cement, the committee desires it to be understood that they are provisional only and are subject to change, but believe they will afford a conservative and precise specification from which a reliable cement can be secured. In their preparation the committee has adopted the recommendations of the progress report of the Joint Committee on Uniform Tests of Cement by the American Society of Civil Engineers, and the International Association for Testing Materials. In recommending the use of a wet concrete, the committee has given the subject the most thorough and careful investigation, and from the preponderance of testimony and the individual experience of its members, believes that the most reliable and economical results can be secured by this method.

SPECIFICATIONS FOR PORTLAND CEMENT CONCRETE.

Cement shall be Portland, either American or foreign, which will meet the requirements of the standard specifications.

Sand shall be clean, sharp and coarse, but preferably of grains varying in size. It shall be free from clay, loam, sticks and other impurities.

Stone shall be sound, hard and durable, crushed to sizes not exceeding 2 in. in any direction and freed from dust by screening.

Gravel shall be composed of clean pebbles of hard and durable stone of sizes not exceeding 2 in. in diameter, free from clay and other impurities except sand. When containing sand in any considerable quantity, the amount per unit of volume of gravel shall be determined accurately to admit of the proper proportion of sand being maintained in the concrete mixture.

Water shall be clean and reasonably clear, free from sulphuric acid or strong alkalies.

Mixing by Hand.—(1.) Tight platforms shall be provided of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least two batches of concrete at the same time. Batches shall not exceed 1 cu. yd. each, and smaller batches are preferable, based upon a multiple of the number of sacks to the barrel.

(2.) Spread the sand evenly upon the platform, then the cement upon the sand and mix thoroughly until of an even color. Add all the water necessary to make a thin mortar and spread again; add the gravel if used, and finally the broken stone, both of which if dry should first be thoroughly wet down. Turn the mass with shovels or hoes until thoroughly incorporated, and all the gravel and stone is covered with mortar; this will probably require the mass to be turned four times.

(3.) Another approved method which may be permitted at the option of the engineer in charge, is to spread the sand, then the cement, then the gravel or broken stone; add water and mix thoroughly as above.

By Machine.—A machine mixer shall be used wherever the volume of work will justify the expense of installing the plant. The necessary requirements for the machine will be that a precise and regular proportioning of materials can be controlled and the product delivered be of the required consistency and thoroughly mixed.

Consistency.—The concrete shall be of such consistency that when dumped in place it will not require tamping; it shall be spaded down and tamped sufficiently to level off and will then quake freely like jelly, and be wet enough on top to require the use of rubber boots by the workmen.

Course.—(1.) Each course should be left somewhat rough to insure bonding with the next course above; and if it be already set, shall be thoroughly cleaned and dampened before the next course is placed upon it. The plane of courses shall be as nearly as possible at right angles to the line of pressure. (2.) An uncompleted course shall be left with a vertical joint where the work is stopped. (3.) The work should be carried up in sections of convenient length, and completed without intermission.

Expansion Joints.—(1.) In exposed work expansion joints shall be provided at intervals of 30 ft. to 50 ft. A temporary vertical form or partition of plank shall be set up and the section behind completed as though it were the end of the structure. The partition will be removed when the next section is begun and the new concrete placed against the old without mortar flushing. Locks shall be provided if directed, or called for by the plans. (2.) In reinforced or steel concrete the length of these sections may be materially increased at the option of the engineer.

Time.—Concrete shall be placed immediately after mixing and any having an initial set shall be rejected.

Facing.—About 1 in. of mortar of the same proportions as used in the concrete may be placed next to the forms, immediately in advance of the concrete, or a shovel facing made, at the option of the engineer in charge.

Forms.—(1.) Shall be substantial and unyielding, properly braced or tied together by means of wire or rods. (2.) The material used shall be of dressed lumber, secured to the studding or uprights in horizontal lines. (3.) Planking once used in forms shall be cleaned before being used again. (4.) The forms must not be removed within 48 hours after all the concrete in that section has been placed. In freezing weather they must remain until the concrete has had a sufficient time to become thoroughly set. (5.) In dry but not freezing weather, the forms shall be drenched with water before the concrete is placed against them. (6.) For backings, undressed lumber may be used for forms.

Finishing.—(1.) After the forms are removed, any small cavities or openings in the concrete shall be neatly filled with mortar if necessary. Any ridges due to cracks or joints in the lumber shall be rubbed down; the entire face shall then be washed with a thin grout of the consistency of whitewash, mixed in the proportion of one part of cement to two parts of sand. The wash should be applied with a brush. (2.) The tops of bridge seats, pedestals, copings, wing walls, etc., when not finished with natural stone coping, shall be finished with a smooth surface composed of one part cement to two parts of granite, or other suitable screenings, or sand applied in a layer 1 to 1½ in. thick. This must be put in place with the last course of concrete. (3.) In arch tops, a thin coat of mortar or grout shall be applied over the top to thoroughly seal the pores.

Proportioning.—The proportion of the materials in the concrete shall be as specifically called for by the contract, or as set forth herein, upon the lines left for that purpose; the volume of cement to be based upon the actual cubic contents of one barrel of specified weight.

SPECIFICATIONS FOR NATURAL CEMENT.

Defined.—Natural cement is a product formed of calcinated limestone containing clay and carbonate of magnesia reduced to a fine powder.

Packages.—Cement shall be packed in well made wooden barrels lined with paper, or in strong jute or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer and the net weights shall be exact and uniform.

Weight.—One barrel shall contain not less than 265 lbs. of cement. Three paper sacks of cement shall be equivalent in weight to one barrel, or two jute sacks containing not less than 133 lbs. to the sack.

Condition.—All cement shall be delivered in sound packages, undamaged by moisture or other causes.

Storage.—Cement must be stored until used in a perfectly dry place in such manner as will insure it from all damage.

Rejection.—All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property.

Tests.—All cement shall be subject to the following tests:

Sampling.—(1.) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample should be a fair average of the contents of the package from which it is taken. At least one barrel in every 10 should be sampled. (2.) Cement in barrels should be sampled through a hole made in the center of one of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to center. (3.) All samples should be passed through a sieve having 20 meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a shipment of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample shall be tested separately.

Fineness.—Not less than 80 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular about 20 cm. (7.87 in.) in diameter, 6 cm. (2.36 in.) high and provided with a pan 5 cm. (1.97 in.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire, having a diameter of 0.0045 in. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 deg. Fahr.) before sieving.

Set.—(1.) Initial set shall not occur in less than 20 minutes. (2.) Final set shall not occur in less than 30 minutes nor more than four hours. (3.) The time of setting shall be determined by means of the Vicat needle apparatus as recommended by the Committee of the American Society of Civil Engineers upon uniform tests of cement, in conjunction with the Committee of the International Association for Testing Materials. (4.) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 in.) above the upper surface of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5.) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39 in.) below the top of the ring. (6.) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 30 per cent. of the weight of the cement. It should have a temperature of 70 deg. Fahr.

Soundness.—(1.) Cold Water Test. A pat of neat cement 2½ to 3 in. in diameter, ½ in. thick at center, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion or softening.

Tensile Strength.—(1.) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 400 lbs. per minute until fractured. (2.) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds should be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould and in smoothing off, the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated on the other side. (3.) Briquettes for 24 hour tests shall be allowed to set one hour in air and remainder of period in water. (4.) Briquettes for seven and 28 day tests shall be allowed to set one day in moist air and remainder of period in water. (5.) All briquettes are to remain in the water until they are placed in the testing machine. (6.) Neat 24 hour tests shall not show less than 60 lbs. per sq. in. Neat seven day tests shall not show less than 100 lbs. per sq. in. Neat 28 day tests shall not show less than 150 lbs. per sq. in., nor less than 25 per cent. above the seven day test.

Specific Gravity.—The specific gravity determined upon dried cement which has passed through a No. 100 sieve shall not be less than 2.50 nor more than 2.80. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus as recommended by the committee on uniform tests of cements.

Uniformity.—If in the tests of any given brand of cement, any sudden irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

SPECIFICATIONS FOR PORTLAND CEMENT.

Defined.—Portland cement is a product of the mixture of clay and limestone in definite proportions, calcinated at a high temperature and reduced to a fine powder.

Packages.—Cement shall be packed in well made wooden barrels lined with paper, or in strong cotton or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer and the net weights shall be exact and uniform.

Weight.—One barrel shall contain not less than 376 lbs. of cement, and four sacks shall be equivalent in weight to one barrel.

Condition.—All cement shall be delivered in sound packages, undamaged by moisture or other causes.

Storage.—Cement must be stored until used in a perfectly dry place in such manner as will insure it from all damage.

Rejection.—All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property.

Tests.

Sampling.—(The specifications for sampling tests are the same as for natural cement.)

Fineness.—Not less than 94 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 in.) in diameter, 6 cm. (2.36 in.) high, and provided with a pan 5 cm. (1.97 in.) deep, and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire, having a diameter of 0.0045 in. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 deg. Fahr.) before sieving.

Set.—(1.) Initial set shall not occur in less than 30 minutes. (2.) Final set shall not occur in less than one hour nor more than 10 hours. (3.) The time of setting shall be determined by means of the Vicat needle apparatus as recommended by the Committee of the American Society of Civil Engineers upon uniform tests of cement, in conjunction with the Committee of the International Association for Testing Materials. (4.) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 in.) above the upper surface of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5.) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39 in.) below the top of the ring. (6.) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 20 per cent. of the weight of the cement. It should have a temperature of 70 deg. Fahr.

Soundness.—(1.) Cold Water Test. A pat of neat cement 2½ to 3 in. in diameter, ½ in. thick at center, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion or softening. (2.) Boiling Water Test. A pat of neat cement as above, placed in water, which shall be slowly raised to the boiling point and then maintained in that condition for three hours and allowed to cool gradually, shall not show any signs of checking, distortion or softening. The same result should follow exposure to steam not under pressure for three hours. This

test may or may not be cause for rejection at the option of the engineer in charge.

Tensile Strength.—(1.) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 600 lbs. per minute until fractured. (2.) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds should be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould and in smoothing off, the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated upon the other side. (3.) Briquettes for 24 hours tests shall be allowed to set one hour in air and remainder of period in water. (4.) Briquettes for seven and 28 day tests shall be allowed to set one day in moist air and remainder of period in water. (5.) All briquettes are to remain in the water until they are placed in the testing machine. (6.) Neat 24 hour tests shall not show less than 125 lbs. per sq. in. Neat seven day tests shall not show less than 400 lbs. per sq. in. Neat 28 day tests shall not show less than 500 lbs. per sq. in., nor less than 25 per cent. above the seven day test.

Specific Gravity.—The specific gravity determined upon dried cement which has passed through a No. 100 sieve shall not be less than 3.10 nor more than 3.30. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus as recommended by the committee on uniform tests of cements.

Chemical.—Chemical analyses should show not more than 3.5 per cent. of magnesia, nor more than 1.75 per cent. of sulphuric anhydride.

Uniformity.—If in the tests of any given brand of cement, any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Exhibits at the Maintenance of Way Convention.

The exhibits at the convention of the American Railway Engineering and Maintenance of Way Association this year showed a gratifying increase in number over the convention of a year ago. The parlor floor of the Auditorium Hotel was used as the exhibit room, as in previous years. Although most of the exhibits were in the form of small models or samples, occupying comparatively little space, nearly all of the available space was taken. Following is a list of the exhibits:

American Hoist & Derrick Co., St. Paul, Minn.—Photographs of cranes, hoists, derricks and hoisting engines.

American Nut Co., Bridgeport, Conn.—Samples of Columbia lock nut.

The American Trackbarrow, Lowell, Mass.—Full-size trackbarrow (described in *Railroad Gazette*, March 13), pony car and timber dolly. Also small models.

The American Washer & Mfg. Co., Newark, N. J., and Chicago.—Samples of nut lock washers, in sizes ⅝ in. to 3 in. Full-size sample of Ward rail joint.

American Valve & Meter Co., Cincinnati, O.—Full-size model and blueprints of "Little Giant" switch stand. Models of Anderson's automatic nut lock. Catalogues of Poage water column.

American Water Softener Co., Philadelphia, Pa.—Model of Brunn-Lowener system of water softening.

E. C. Atkins & Co., Indianapolis, Ind.—Samples of Atkins silver steel hand saws, hack and crosscut saws.

Atlas Railway Supply Co., Chicago.—Samples of Atlas insulated rail joints, suspended and supported patterns; Atlas rail brace and Atlas tie plate.

The Avery Stamping Co., Cleveland, O.—Samples of hollow and smooth back railroad shovels.

Barnett Equipment Co., New York.—Blueprints and photographs of automatic safety chains.

Buda Foundry & Mfg. Co. and Paige Iron Works, Harvey, Ill.—Buda semaphore switch stand, Buda derail, Ramapo switch stand, Paulus track drill, Wilson track drill, pressed-steel hand and push car wheels.

Cambria Steel Co., Philadelphia.—Models of "100 per cent." rail joint.

A. M. Castle & Co., Chicago.—Model of "Neafie" insulated rail joint.

H. Channon Co., Chicago.—Samples of shovels, Ajax rope, and tackle blocks; small model of Badger solid earth digger; full-size sample of William's track man for clamping and compressing angle bars to rails.

Chicago Crossing Co., Chicago.—Samples of Ball's spring fasteners for bolts; model of joint with fasteners applied; base plate for rail joints.

Chicago Pneumatic Tool Co., Chicago.—Samples of Boyer pneumatic hammers, "Little Giant" piston air drills.

Chicago Steel Tape Co., Chicago.—Sample line of steel tapes and leveling rods; printed cloth rods for attachment to any convenient stick.

Clark Automatic Scales Co., New York.—Small working model of automatic scales for weighing coal, grain and cereals. Photographs.

Climax Fence Post Co., Chicago.—Samples of composite vitrified-clay and steel fence posts.

Climax Stock Guard Co., Chicago.—Samples of Climax vitrified-clay stock guards.

Columbus Steel Rolling Shutter Co., Columbus, Ohio.—Full-size working model of steel rolling door for 4 x 6 doorway; model of fire door equipped with fuse, for release by heat.

Cortright Metal Roofing Co., Philadelphia, Pa., and Chicago.—Samples of metal shingles.

Crerar, Adams & Co., Chicago.—Sample "Wells" light of 4,000 c.p.

Alphons Custodis Chimney Construction Co., New York and Chicago.—Samples of perforated radial brick for chimneys.

Diamond State Steel Co., Wilmington, Del.—Easel showing sections of tie plates, spikes and angle bars.

Paul Dickinson, Chicago.—Small model of the Dickinson cast-iron smoke jack.

Dilworth, Porter & Co., Ltd., Pittsburg, Pa.—Samples of Glendon flange tie plate, Goldie claw tie plate and Goldie "Perfect" spike.

Dressel Railway Lamp Works, New York.—Samples of signal lamps, switch lamps, and four-way reflector for switch lamps.

Edison Mfg. Co., Orange, N. J.—Sample types of Edison-Lalande batteries, and of the new Edison storage battery.

Fairbanks, Morse & Co., Chicago.—Catalogues, pamphlets and photographs of pumping engines and machinery, oil and gasoline engines, locomotive coaling stations, etc.

George Fuller, assisted by Spencer Otis Co., Chicago and Omaha, Neb.—Easel of samples illustrating stages of rolling a Hart tie plate from billet to finished plate. Sections of hard and soft wood ties with tie plates imbedded.

General Manifold Co., Franklin, Pa.—Sample forms of requisition books, train orders, telegraph blanks, etc., illustrating system of duplicating without separate carbon sheets.

Wm. Goldie, Jr., & Co., Pittsburg, Pa.—Samples of Goldie "Perfect" tie plug.

Goodwin Car Co., New York.—Small working model of Goodwin gravity-dumping air-operated car. Photographs and catalogues.

The Gordon Railway Joint & Nut Lock Mfg. Co., Chicago.—Full-size model of rail joint and nut lock.

Holme Continuous Rail & Forging Co., Pittsburg, Pa.—Large and small models of the Holme continuous rail joint.

Hussey-Binns Shovel Co., Pittsburg, Pa.—Samples of spades, shovels and scoops.

Independent Railroad Supply Co., Chicago.—Samples of Wolhaupter standard rail joint, Wolhaupter "C" rail joint, "Chicago" and "Federal" tie plates. Section of Wolhaupter rail joint.

The International Fence & Fireproofing Co., Columbus, Ohio.—Samples of wire fencing.

Illinois Malleable Iron Co., Chicago.—Small working model of Bruyn swinging automatic smoke jack.

International Steam Pump Co., New York.—Large photographs of air compressors and pumps.

Kenyon & King, South Omaha, Neb.—Small model of device for blocking and derailing cars.

Keuffel & Esser Co., New York.—Samples of steel and metallic tapes, surveying instruments, mining transits and railroad levels.

Kinnear Mfg. Co., Columbus, O.—Working model of steel rolling door. Photographs showing installations. Sections showing construction.

Link-Belt Machinery Co., Chicago.—Large photographs of locomotive coaling stations.

Lufkin Rule Co., Saginaw, Mich.—Comprehensive line of steel, linen and metallic tapes, chain tapes and steel scales.

Mann-McCann Co., Chicago.—Photographs of McCann spreader and grader car, and Creese track mover.

W. N. Matthews & Bro., St. Louis, Mo.—Samples of Stombaugh anchor guys—12-in. for wrecking and 6-in. for poles and permanent guying.

McCord & Co., Chicago and New York.—Small model of Gibraltar bumping post.

Morden Frog & Crossing Works, Chicago.—Small model of double slip switch with movable points controlled by one stand with four-way movement. Samples of Duplex guard rail clamp, adjustable open-side switch socket, and Union track jack.

National Lock Washer Co., Newark, N. J.—Samples of lock washers.

National Coal Dump Car Co., Chicago.—Circulars illustrating and describing the National coal dump car.

A. E. Oblander, Chicago.—Small model of McMahon steel car bumper.

Otto Gas Engine Works, Chicago.—Photographs and drawings of Snow-Moore water crane, gas engines and gasoline-engine operated coaling stations.

Page & Schnable, Chicago.—Photographs of Ashland avenue (Chicago) bascule bridge; small wooden model of one leaf.

Park Mfg. Co., Chicago.—Photographs, blueprints and circulars of Park automatic loaders.

Peak & McCaleb, Bluffs, Ill.—Small wooden model of automatic railroad and street car switch.

E. L. Pence, Memphis, Tenn.—Small working model of automatic switch operating device to prevent train running into open switch.

Pennsylvania Steel Co., Philadelphia.—Small models of spring rail frog, split switch, reinforced split switch with adjustable connecting bar, anvil-face frog, New Century adjustable switch stand, Challenge switch adjustment, Long safety switch stand, Acme rail brace, switch socket, New Century switch stand.

Pittsburgh Tool & Drop Forge Co., Pittsburg, Pa.—Samples of track tools.

Positive Lock Washer Co., Newark, N. J.—Samples of lock washers.

Pyle-National Electric Headlight Co., Chicago.—Exhibit of "Ideal" acetylene car lighting system, comprising tank, reducing valve and two ½-ft. burners.

Railway Appliances Co., Chicago.—Full-size model of Bonzano rail joint.

Railroad Supply Co., Chicago.—Samples and models of Q. & W. and Wolhaupter tie plates; books on "Track;" sections of tie plates.

Ramapo Iron Works, Hillburn, N. Y.—Ramapo automatic switch stand, geared type, with adjustable crank and connecting rod.

Rand Drill Co., New York.—Drawings and catalogues of air and gas compressors.

Rodger Ballast Car Co., Chicago.—Catalogues, photographs and prints of Hart convertible ballast distributing cars.

St. Louis Expanded Metal Fireproofing Co., St. Louis, Mo.—Sample sections of corrugated steel bars for concrete-steel construction.

St. Paul Railway Supply Mfg. Co., St. Paul, Minn.—Small working models of Dunn safety appliance for point switches, new automatic mail catching and discharging device, Walker car replacer, St. Paul oil box jack, St. Paul continuous rail joint (full size), St. Paul dust and oil guard, St. Paul rail brace (three styles), Murray track spacing jack, and Bossart three-throw split switch.

Scherzer Rolling Lift Bridge Co., Chicago.—Large and small albums of photographs of Scherzer rolling lift bridges.

The Sherwin-Williams Co., Cleveland.—Large reproduction of "Metalastic" trade-mark. Metal samples painted with "Metalastic."

Smith Railway Mail Service Co., Rochester, N. Y.—Small working model of Smith crane and catcher. Full-size samples.

Spring Steel Fence & Wire Co., Anderson, Ind.—Sample section of Shimer fence in frame.

Standard Paint Co., New York.—Samples of Ruberoid roofing for buildings.

Steel Cable Engineering Co., Boston, Mass.—Blueprints and photographs of conveying machinery for coaling stations.

Stromberg-Carlson Telephone Mfg. Co., Chicago.—Samples of telephone apparatus, and of special equipment for railroad use.

Tippit Nut Lock Co., Bluffs, Ill.—Samples of nut locks.

U. S. Track Gage Co., St. Paul, Minn.—Small working model of car equipped with track gage; also full-size sample gage.

Universal Safety Tread Co., New York.—Sample sections of car step and stair treads.

Variety Mfg. Co., Chicago.—Small working model of the Cross horizontal folding door. Photographs showing application.

R. V. Wallace, Marvel, Ark.—Small model of Wallace surface cattle guard.

Weber Railway Joint Mfg. Co., New York.—Samples and sections of the Weber rail joint.

Wells Light Mfg. Co. (Edward Robinson, Sole Proprietor), New York.—Full-size model of a "Wells" light of 4,000 c.p. During the convention an exhibition was given at night on Congress street, near the Auditorium Hotel, to show the power of the light.

Walter A. Zelnicker Supply Co., St. Louis, Mo.—Pritchard pressed-steel car replacer, Zelnicker rail bender, sledge, maul and tool handles; Zelnicker metal worker's, waybill checking and lumber crayons; metal insertion packing; Zelnicker switch locks and double-catch car mover.

Classification of Excavated Materials.*

The subject of discussion at the Maintenance of Way Committee was the following "conclusion" of the committee, recommending: "A three-fold classification of materials; solid rock, loose rock and common excavation, . . . and in special cases such additional class of material as may seem necessary, such class to be specified in the contract."

The President: Conclusion No. 3 is before the Association: "A three-fold classification of materials—solid rock, loose rock, and common excavation—as described in the foregoing specifications."

Mr. Walter G. Berg (Lehigh Valley): I think the first question that ought to be settled is, whether three classes of material ought to be the standard classification or four classes. On many roads there are still four classes—solid rock, loose rock, hard pan and dirt, or, as they may be specified. I think that is the first question to eliminate. I will say, personally, I am in favor of three classes. . . . I think it would be desirable to establish, by discussion or vote, whether the three classes are preferable to four classes, and therefore I make a motion that it is desirable to have four classes of material in place of three.

Mr. G. A. Mountain (Can. Atlantic Ry.): It is very difficult in my experience to omit a fourth class, such as hard pan, cemented material, etc. It might be taken into consideration that the contractor bidding on the work in which there was only three classes, would put a high price on the third, that is, in excavation, and if hard pan, cemented material, etc., were not discovered in the excavation, the company would be a good deal out.

Mr. McNab: If the several grades or classes of material were distinctly defined on the ground, the work of classification would be very simple; but as a fact one grade is so blended into another it is difficult to tell where one class begins and another ends. It was to afford the simplest method, and the one which in the end would be most satisfactory to both parties that the committee had in view in this three-fold classification.

Mr. Berg: I think every engineer is fortunate who starts in on a contract with only three classes of material. But if hard pan and cemented material develops, there is found to be more or less dispute with the contractor on the subject, and it is quite a serious question whether to recognize at the start that there are four classes of material. A number of railroads in this country follow the European methods largely. On the Pennsylvania, for instance, there is no classification whatever; in other words, there is one class of material.

Mr. A. W. Sullivan (Illinois Central): The cheapest work I ever saw done was on a road where they had six or seven classifications, a road 100 miles long. Personally I would rather have one classification, as Mr. Berg suggests. If we cannot have that, then I would like the three classifications.

Mr. Felt (Gulf, Colorado & Santa Fe): I have come to the conclusion that specifications that describe the work that we have to do the more closely are the better. In Texas we have a class of material that perhaps in the north you do not have, and that is wet gumbo. I have had contractors tell me that that cost them more than loose rock, and we have been obliged to recompense them by allowing a classification of loose rock. That looks wrong, and shows one of the complications we have to meet. It seems to me that that classification ought to be covered in some way better than by simply arbi-

*From discussion on the committee report on specifications for the formation of a roadway before the American Railway, Engineering and Maintenance of Way Association, March 17-19, 1903.

trarily allowing a certain percentage on loose rock. I think the general idea that was presented for the six or seven classifications is really the correct one.

Mr. Kelley (Iowa Central): In Mr. McDonald's discussion, I think he has reached a very happy conclusion. . . . I would ask if cemented material could not be properly classified in one of these three terms? Most of our cemented material is in the classification "medium," and you will find could be removed at the price necessary to remove that material.

Mr. Slifer (Chicago & North Western): There is a wide latitude in this question; like every other one, there are two extremes. One is to adopt the classification of the Pennsylvania of having one single classification for everything. The other is to describe every kind of material that is apt to be handled. There seems to be one feature in connection with this question that has not been brought out in the discussion, and that is that it is good railroad practice to-day to require your contractor, and also your sub-contractor, to go over a piece of work and determine for himself, in advance of his bid, the classes of material; and he can do that just as well as the engineer can do it.

Mr. Sullivan: I went over seven miles of work a year ago, and I put in preliminary estimates for 80 per cent. of earth. It turned out to be 90 per cent. cemented gravel, and genuine cemented gravel. The contractors had the same idea.

Mr. Slifer: I was connected with the construction of 85 miles of line of railroad through the woods, where we opened test pits in the cut, and determined just what it was, and so did our contractor.

The President: I would like to ask Mr. Felt if Mr. McDonald's classification would take care of his wet gumbo?

Mr. Felt: Not exactly, unless it was changed to "hard," "medium," or "wet," or something of that kind.

Mr. Tye (Canadian Pacific): This Committee cannot possibly get up a specification to govern all cases. If a lot of this wet gumbo (it prevails in the north as well as the south) is found the chief engineer could make his classification include it. I propose to put in my new specifications that three classifications shall govern, but in special cases where there is a great amount of hard pan, or cemented gravel, or this wet gumbo, we will introduce a fourth. As a general rule for all the railroads of the country I think three would do, with the understanding that the chief engineer is allowed to put in the fourth whenever he wishes.

Mr. Berg: I offer the amendment to the previous amendment that in place of a four-fold classification there be a three-fold classification, and in special cases such additional classes of materials as may seem necessary; such additional class or classes to be distinctly defined and specified in the contract.

Mr. McNab: The Committee will accept that amendment.

The President: The report of the Committee then will substitute the suggestion of Mr. Berg's, for the first part of conclusion 3. Now, the remaining part of conclusion 3 remains to be discussed. We will advance to the names of the classifications. The Committee has reported "solid rock," "loose rock," and "common excavation."

Mr. Berg: I move as an amendment to the Committee report that we substiture the names "hard," "medium" and "soft," for "solid rock," "loose rock" and "earth."

Not carried.

The Committee recommendation was then adopted.

The President: All that remains of conclusion No. 3 is "as described in the foregoing specifications."

Mr. McNab: The Committee desires to change the construction of that sentence of description to read as follows: "Solid rock shall comprise rock in solid beds or masses in its original position, which, in the judgment of the engineer, may be best removed by blasting, and boulders or detached rock, measuring one cubic yard or over." For loose rock, the definition as amended by the Committee will read as follows: "Loose rock shall comprise all detached masses of rock, or sand of more than 1 cu. ft. and less than 1 cu. yd. in bulk, and all other rock which, in the judgment of the engineer, can be properly removed by pick and bar and without blasting; although blasting may be resorted to on favorable occasions in order to facilitate the work."

Mr. Churchill: I would like to propose a modification: "Loose rock shall comprise shales, sub-stone and such stratified rock or cemented material which can be properly removed by pick and bar," etc.

Mr. A. S. Baldwin (Illinois Central): The specification of loose rock is anomalous, and it is subject to two very distinct objections. One is that when an engineer is compelled to go before a court, it is decidedly disagreeable to him to have to explain to the court why he has been calling a certain material "rock" or "loose rock," when there is really no rock about it.

Mr. Churchill: I think we should go to some detail in these definitions. We can't afford to make them so general that sub-contractors and the courts also should not know what we mean by these general terms that we adopt for paying contractors.

Mr. Berg: I understand that the advocates of the intermediate class of classification of materials, the fourth class largely, base their arguments on the fact that they pick for cement material. The clause as it now stands provides for three materials, optional to any additional classes of material in special cases, so as to allow for gumbo, cemented material and so forth. Now, if we put in it loose rock, we are taking away one of the principal reasons made for having the option to adopt a special class, namely, to cover cemented gravel.

Mr. Churchill's amendment was not carried. The Committee definition of loose rock was then accepted as modified.

Mr. McNab: On account of the fourth classification which has been adopted, it will be necessary to add a rider to the Committee's definition of common excavation, which will read as follows: "Common excavation shall comprise all other materials of whatever nature that do not come under the classification of solid rock, or loose rock, or such special classification as shall be established before the award of contract."

The addition to the definition consists in the words, "or such special classification as shall be established before the award of contract." This definition was adopted.

Ballasting.*

Engine Cinders.

Roads having a total trackage of 72,055 miles (46,894 miles of it main line), report 5,186 miles of ballast with cinders; 7,753 miles with stone, and 16,331 miles with gravel. If cinders are wet down immediately after being drawn they will make better ballast than if allowed to continue to burn.

Engine cinders make a good ballast for sidings, yards and lines of light traffic; they make a good sub-ballast on new work where dumps are settling, etc.; they are good in wet places; they are good on temporary work; they are easily handled. Anthracite coal cinders are better than soft coal, and there is considerable difference in the quality of cinders obtained from different kinds of soft coal. The chemical action tending to destroy rails and ties probably varies greatly, but generally the effect on both ties and rails is injurious to a greater or less extent. They should not be used on main lines subject to heavy traffic.

Stone Ballast.

1. *Quality.*—(a.) Stone should be durable enough to resist the disintegrating influences of the climate where it is used. (b.) It should be hard enough to prevent pulverizing under the class of traffic to which it is subjected. (c.) It should break in angular pieces when crushed.

2. *Size.*—(a.) It is recommended that the maximum size of ballast shall not exceed pieces which will pass through a 1¾ in. ring, but a ring of 1½ in. diameter is preferred as the maximum measure of size. (b.) It is recommended that the minimum size will not pass through a screen with ¼ in. holes.

3. *Quantity in Track.*—(a.) It is recommended that the minimum thickness of 6 in. under the tie be considered as ballasted track, but that a minimum thickness of 8 in. under the tie is preferred. (b.) The extreme maximum thickness of 18 in. under the tie is recommended, with an ordinary maximum of 12 in. (c.) The upper surface of the ballast should be level with the top of the ties. (d.) The upper surface of the ballast should extend 9 in. beyond the ends of the ties. (c.) The slope should not be steeper than 1½ to 1.

Burnt Clay.

Burnt clay or gumbo ballast is of quite recent use, and nearly, if not quite, confined to the territory in the central basin of the country where sufficient quantities of good stone or gravel cannot be obtained without excessive cost.

(a.) It should be made from clay free from sand or soil and should be thoroughly tested in small test kilns before establishing a ballast kiln. (b.) Clay must be thoroughly burnt. (c.) Coal must be fresh and clean enough to burn with a clean fire. (d.) Quantity of fuel and time of burning will vary with the nature of the clay and the weather conditions. (e.) Burning should be done under the supervision of an experienced and competent burner. (f.) Care should be taken that fuel is always on hand when required. (g.) Ballast should not be loaded out of the pit hot. (h.) Absorption of water should not exceed 15 per cent.

Where fuel is cheap and suitable material can be obtained, clay ballast can be obtained f. o. b. at about the same cost as crushed rock. The cost of putting burnt clay ballast under the track is much less than for stone, and for a time much easier to maintain. From reports from several roads using it, the life of burnt clay ballast seems to be from four to eight years, depending on the quality of same and the amount of traffic it has to sustain.

Gravel Ballast.

Gravel to make good ballast must be composed of firm particles that will not readily decay, and in sizes running from coarse sand to 1½ in. in diameter. It must be sufficiently free from clay and soil to allow drainage. Gravel ballast of irregular boulders and containing considerable clay can be made into first-class gravel, usually, by passing it through a washer and crusher, the larger boulders being crushed into small, irregular masses, giving a superior holding quality on the tie, and the washing will make the ballast drain so it will not churn in wet weather.

Conclusions.

With the increase of speed and weight of engines and cars, the duty called for on ballast has grown more exacting, and materials that gave satisfactory results under 30,000 lbs. axle loads fail in a short time under 45,000 and 50,000 lb. axle loads now coming into use.

Except where an exceptionally good quality of gravel is obtainable, it is the opinion of the committee that only stone ballast, made from hard durable stone and broken in sizes from ¼ in. to 1½ in., and having a depth of 12 in. under the tie, resting on a firm, well-drained roadbed, will meet the requirements of roads with heavy traffic using maximum sized engines and having fast service.

Ballast may fail from a variety of causes. It may not stand the action of the weather. This is true of most sandstones, some limestones, and most artificial ballasts. It may not have sufficient strength to resist crushing. This is true of some rocks, slags, cinders, chats and artificial ballast.

It may wear out and become pulverized by the grinding of the pieces against each other and from frequent tamping. This is true of all ballast more or less, but is less marked in good stone and gravel than with other varieties.

It may fail for want of weight or cohesion, and be blown or washed away, and fail to hold the tie in position. This is true of sandy gravel and chats.

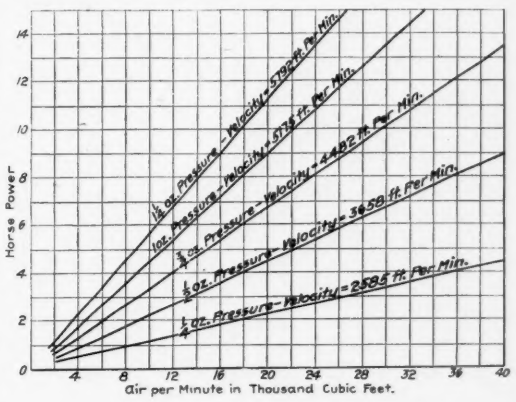
It may fail on account of a large part of the pieces being of a globular shape, with smooth surfaces, which allow the pieces to move as well as the tie. This is generally true of beach or river bed gravel and some pit gravel.

It may fail for want of support from below, especially if the top of the roadbed becomes concave and has defective drainage. This is a failure of the roadbed rather than the ballast.

*Extracts from the report of the Committee of the American Railway Engineering and Maintenance of Way Association, March, 1903.

Heating and Ventilating of Railroad Shops.*

I very vividly remember, while serving my apprenticeship as a machinist in a railroad shop that the temperature in the shop often dropped below 40 deg. and frequently to freezing if the outside weather was within 15 deg. of zero. With a temperature of 40 deg. a workman's hands become numb, and it is almost impossible to do good work with hand tools. This shop was considered by those in charge as being amply heated with an overhead direct steam system. The employees, instead of working to keep warm, as a rule chose to loaf to keep warm, and I do not believe that the amount of work produced on such cold days, when estimated very conservatively, amounted to more than 75 to 80 per cent. of the normal output. In this building there were about 150 employees earning approximately $250 per day; considering, however, the output to be 85 per cent., the loss on cold days amounted to something like $37.50.



Horse Powers of Steel Plate Centrifugal Fans.

An efficient heating plant for this shop would cost about $3,750 complete. Without considering the cost of steam, of which there was plenty of exhaust going to waste; allowing for depreciation, etc., making a liberal total of 12 per cent. or $450 per year as the amount that the cost of the heating plant should earn, it would take only 12 days with the thermometer below 15 deg. above zero to make the expenditure a paying investment.

Practically all railroad shops have exhaust steam from the shop and electric lighting engines and air compressors which is available for heating, so any system not adapted to the economical use of exhaust steam should not receive serious consideration. In considering the advisability of utilizing exhaust steam and returning the water of condensation to boilers, the questions of back pressure and cylinder oil carried over with the steam should not be overlooked.

Regarding the question of back pressure and the minimum required for the various systems of heating, it will be found that ordinarily five pounds is carried, and while this could be reduced in moderate weather, the general practice is to establish this as the minimum and increase the pressure in extremely cold weather. With a carefully designed plant, however, this is higher than should be necessary unless there are some adverse conditions. The minimum pressure required for circulation depends more upon a proper proportioning of the supply main, and the distributing branches, than upon the return main. The question of expansion of the steam and the proper removal of the condensation at the required points in the supply main should receive careful consideration. A great many plants require a higher pressure to secure circulation than would otherwise be necessary had

*Abstract of a paper presented to the New York Railroad Club, March 20, 1903, by Mr. J. I. Lyle, Mechanical Engineer, Buffalo Forge Co.

proper consideration been given to the dripping of the mains and its branches.

Wherever possible, the use of traps in return lines should be avoided as a pump and receiver or the boiler feed pump controlled by a pump governor make the best kind of trap. . . . The three systems adapted to the use of exhaust steam are:

First: Direct steam heat, consisting of pipe coils placed along the walls or overhead.

Second: Direct hot water, where the exhaust steam is used in some form of feed water heater to heat the water which is circulated either by gravity or a force pump through the direct coils in the building.

Third: The fan system, where steam coils consisting of wrought iron pipe are placed in one or more groups and air drawn over these coils by a fan and forced into the building.

The sole advantage of direct steam for shops is its extreme simplicity, requiring for its operation the opening and closing of a few valves. This feature is a good one, but it is offset by the disadvantages of having the heating surface distributed through the shop where it is always subject to damage from many sources. Very often it is difficult to place the coil surface to procure proper drainage.

With the installation of overhead cranes in shops covering considerable area, and especially those provided with a monitor type of roof, it becomes a difficult problem to install a direct system of either steam or hot water, and an installation of this type frequently requires changes in shafting and machinery to make room for the required amount of heating surface. As a rule, a great deal of glass surface with its high condensing influences requires a large amount of coil surface that cannot be completely installed satisfactorily below windows and between door openings. Coils overhead do not secure an equal distribution of heat satisfactorily, and while the fan-like effect is obtained from the pulleys and belts when the plant is in operation, during the time the plant is idle the bulk of the heat is where it is least required. Often to secure a perfect circulating system it becomes necessary to install a considerable amount of trenching. Trenching as far as practicable should be eliminated from shops, as it becomes a pocket for the collection of dust, waste, water from leaks, etc.

Direct hot water lays claim to the advantages in comparative simplicity and in control of the temperature, but on the other side of the balance sheet it has the same disadvantages of having the heating surface spread throughout the shop subject to injury. The fan system has the advantages of having all the heating surface assembled in one place. Nearly all the heating surface can be set vertically, thereby procuring perfect drainage. The warm air being forced into the building, a constant circulation of the air is maintained, thus heating all portions of the building more evenly than with any other system. Because of this forced circulation there is a less difference between the temperature of the air near the floor and that near the roof, than when natural circulation is used. Its disadvantages are in having a fan and engine or motor to be cared for, and in having large hot air pipes placed overhead.

The fans installed in the various railroad shops differ very materially in their design. Two types of fans are used for heating: the disc or propeller type, and the centrifugal or steel plate type. The latter is used almost exclusively, as the disc fans, except for very small installations have not been a success. With the centrifugal type of fan, the most economical results for heating are obtained when running the fan in coldest weather at a speed so the periphery of the wheel will travel at a velocity of approximately 4,500 to 5,200 ft. per minute. In no part of a fan system design does practice differ so greatly as in construction and location of the hot air ducts. Several schemes are used, the most common being to construct the ducts of galvanized iron and to carry the horizontal runs overhead through the truss work, with warm air outlets spaced from 15 to 40 ft. apart, these outlets being placed from 8 to 20 ft. above the floor.

In the early installations the idea was to distribute very thoroughly, through ducts running practically all over the shop, a relatively small volume at a high temperature and to discharge it 6 ft. or 8 ft. above the floor and direct it so it would blow on the workmen. This practice resulted in much adverse criticism of the fan system, as the workmen in the line of the discharge were given colds and would be overheated, while those not in the direct path would not be heated sufficiently. The later practice for large shops has been to use large volumes of air at rather low temperatures and to use much shorter pipes and allow the air to travel free in the building for some distance. The outlets are usually from 10 ft. to 20 ft. above the floor. In this design advantage is taken of the fact that the warm air discharged high up travels toward the walls where it is cooled and becoming heavier falls to the floor, thus the walls assist the circulation. The direction of the winds largely determine the coldest side of a building and as the temperature of the wall will control to a certain extent the air currents, the coldest wall will cool the greatest amount of air, consequently the more air will be drawn in that direction. With the older installations of thorough distribution this was not accomplished so well and generally one side of the shop would be better heated than the other. Another advantage in placing the outlets high is that no air currents are felt by the occupants on the floor. Heating plants in machine shops are in successful operation now where the air is discharged 100 to 175 ft. from the ends of the buildings, and in foundries it is blown as far as 250 ft.

Masonry or concrete ducts placed under the floor with standpipes placed at intervals and extending above the floor from 8 to 12 ft. are in many cases used. In the Brown Hoisting Machinery Co., Cleveland, O., shops, the underground concrete duct is used and connected to the hollow steel columns supporting the building, which are used for the risers, discharging the air about 4 ft. above the floor. In the Philadelphia & Reading shops, at Reading, Pa., no distributing pipes are used, but the hot air is discharged from the fan into the building overhead and the air returned to the apparatus by means of underground ducts with openings at the floor line and distributed through the shop.

The velocities of the hot air in the main ducts leading from the fans should never be greater than 2,500 ft. per minute, and this velocity should be reduced gradually in the different branches so that the air is discharged from the outlets at from 800 to 1,200 ft. per minute. Where the outlets are high as in large buildings, 1,200 ft. per minute can be used without any objectionable results; but where a thorough distribution is desired, and the outlets are placed within 6 or 8 ft. from the floor, the velocity of air from the outlets should not be greater than 800 ft. per minute.

In any shop installation, provision should be made for re-circulating the air also for the use of cold fresh air from the outside of the building. Occasionally it is found that a building can be heated easier by using part outside air and part return air than to use all return air. This is accounted for in the following way: Where the fan is blowing into and exhausting from the building as in re-circulating, the pressure maintained in the building is not greater than the outside, so the leakage of air around windows, doors and crevices may be very great, while by the use of a part fresh outside air a slight pressure can be maintained and to a large extent prevent this inward leakage. In either case cold air will of course be entering the building, but in the latter case the outside air will pass through the heater where it can be heated more economically and easier than by mixing it with the heated air in the building as it leaks in. In some cases it is found difficult to maintain uniform temperature throughout the buildings when using entirely return air, because it is difficult to keep the lower strata of air along the floor sufficiently warm, owing to leakage, though in the upper part of the building the temperature may be as high as 80 or 85 deg. Because of the influence of local conditions, fan makers hesitate to give out data about their apparatus. The capacity of the steel plate centrifugal exhaust fan (inlet on one side only) when running under "free delivery" will be given approximately, however, by the formula:

$$C=1.57\ D^2WR.$$

In which C=capacity in cu. ft. per minute. D=diameter of the blast wheel in ft. W=width of the blast wheel at the periphery in ft. R=r.p.m.

By "free delivery" is meant to set the fan in the room and simply draw the air into the inlet and discharge into the same room without any piping, thereby avoiding ducts with the attending friction, other than the air passing through the fan.

In factory buildings, where short pipes of rather large diameter are used, thus reducing the friction, the formula $C=1.25\ D^2WR$ will be found to be approximately correct. With long ducts terminating into many small outlets, the capacity will reduce from 10 per cent. to 20 per cent. as given by this last formula.

The delivery or capacity of a fan within the limits used in heating, varies directly as the speed of the fan. In a good installation with the fan running with a peripheral velocity of 5,200 ft. per minute (approximately 1 ounce pressure with air at 62 deg.) from 2,200 to 2,500 cu. ft. of air per minute will be delivered per horse power expended.

By proportioning the fan to meet the severest conditions of weather, say, zero or colder, then in moderate weather of 20 deg. to 25 deg. above zero the fan will do the work easily at three-fourths the speed; the delivery varying with the speed and the horse power will be reduced more than one-half, giving 3,850 to 4,300 cu. ft. of air delivered per minute per horse power. As the number of zero days during the winter are comparatively few, it will be found in the majority of cases that the cost of power to run the fans on such days at one ounce pressure is less than the interest on the increased cost of a larger fan designed to operate at a slower speed in the severest weather.

As to whether a steam engine or electric motor is the better for driving the fan depends upon the local conditions. If there is not sufficient exhaust steam to do the heating, an engine driven fan is the more economical as its exhaust can be used. Fully 75 per cent. of the heat of the steam supplied to the engine is available for heating, as the cylinder condensation and expansion will not amount to more than 25 per cent. An engine driven fan also has the additional advantage of being independent of the electric plant; so the heating plant can be operated when the electric plant is shut down. Where electric current is constantly available together with sufficient exhaust steam, an electric motor is the most convenient and economical, as it is probable the electric generating units in such cases are large and consequently more economical than a small steam engine. If the fan apparatus is placed very far from the source of steam supply, the condensation in high pressure steam pipes necessary for an engine is an item well worth saving. Where engines are used, it is preferable to have them direct connected, but belted electric motors are preferable because of the large and expensive motor necessary for direct connection on account of the slow speed of the fan.

The curve shows the horse power required to move a given volume of air at different velocities or pressures.

DISCUSSION.

Mr. E. C. Childs, of the B. F. Sturtevant Co., was in favor of the hot blast system whenever it was practicable, and he said that it is only lately that employers have begun to realize that the comfort of workmen is a matter deserving serious consideration. The advantages of the hot air system are the great convenience in handling together with the economy and ease with which the temperature may be regulated. In addition to this, all the heating apparatus is enclosed in a steel housing, which greatly lessens the fire risk. It also makes possible thorough ventilation in summer. The disadvantages which are sometimes claimed for the hot air system are merely nominal, and while it is true that the engine requires attention this is a minor feature, especially in a machine shop where similar units are used.

He did not agree with the writer of the paper as to the most satisfactory method of distributing the air. He thought that an arrangement whereby the pipes discharge towards the floor from the side wall was the most desirable. In general, the pipes should be about 8 ft. above the floor. The problem of successful heating was to keep a blanket of hot air around the interior of the walls. If this is done, the remainder of the shop will be heated without difficulty.

In paint shops the hot blast system is desirable, and in any design of this kind it should be kept in mind that an absolutely dustless system is desired, and for that reason the air velocities should be low. In order to accelerate the drying, the temperature should be relatively high. The desirable construction is to have a drop at every post. In order to give a good circulation a counter exhaust should be used.

Mr. George L. Fowler told of two roundhouses which he had visited. They were about 10 miles apart, and were therefore subjected to practically the same temperature and weather conditions. One of these was heated by direct steam and the other by a hot air system. In the steam heated house on a cold day the air was exceedingly foggy, while in the blast heated house such conditions did not prevail. He explained this by saying that with the hot blast system the air being heated as it entered the shop has a greater capacity for moisture, or, in other words, the dew point is raised. In the direct system of heating, the colder air coming in contact with the wet engine produced condensation which appeared in the form of a fog.

The use of a re-circulating system in a paint shop should be considered with some caution. He knew of one case where the varnish was practically ruined by such a system; the reason being that the air became saturated with moisture which condensed about the roof and fell in the form of a light spray. He thought the height of the roof was an important factor, and that the disadvantages of the system in paint shops was magnified by low roof construction.

Mr. George W. West, Superintendent Motive Power of the New York, Ontario & Western, gave his experience with the hot air system in the shops on his road, all of which was entirely favorable.

Mr. Lyle again called attention to the disadvantage of blowing the air, whether it be hot or cold, on the men. He did not think that a system which delivered the air towards the floor was desirable, inasmuch as it was sure to hit the men and give them colds. He cited several new installations in which the system of blowing towards the wall is in use and stated that these installations were giving entire satisfaction.

Professor Hibbard, of Cornell University, said that there was a natural tendency for smoke, steam and gases to stay in the roundhouses, and unless a good system of forced circulation was used this nuisance could not be overcome.

Mr. C. H. Gifford, of the B. F. Sturtevant Co., said that his company had now adopted the system of blowing the air towards the floor, and that the adoption of this system was the result of experience with every other known method. He told of the difficult problem which came up for solution in the shop of the New York Shipbuilding Co. This building is about 1,000 ft. long, 200 ft. wide and 80 ft. high. It was only desired to heat one-half of the building, while the other half was to remain at the temperature of the outside. At first, it was not thought that this could be done, but the contract was finally taken and a wall about 8 ft. high was built across the shop. The hot air pipes were then distributed about the portion to be heated and the hot air directed towards the floor. He stated that entire satisfaction was given, and that on one side of the wall relatively high temperatures could be maintained, while on the other side it was decidedly cool. He thought that a proper consideration of the distribution of the air was always to be desired, and that $50 well spent in distributing the hot air would result in a saving of $100 in the apparatus to be installed.

In regard to the use of hot air in paint shops, he said that chemists had told him that the drying of paint was an oxidizing process, and hence the blast system is preferable.

Mr. Wm. McIntosh, Superintendent of Motive Power of the Central of New Jersey, said that he had used the

hot air system in his paint shops, and that no bad results were noted. The air, however, was screened before being discharged into the shops, thus removing the dust and other suspended matter.

Coal Strike Commission's Awards.

The awards made public on March 21 by the Anthracite Coal Strike Commission is briefly summarized as follows:

First.—Ten per cent. increase, dating from Nov. 1, 1902, in rates to contract miners; to continue to March 31, 1906.

Second.—Ten per cent. increase from Nov. 1, 1902, to April 1, 1903, and eight-hour day for hoisting engineers, other engineers and pumpmen. After April 1 next they are to have another 5 per cent. increase. Firemen have a 10 per cent. increase in their wages from Nov. 1, 1902, to April 1, 1903, but after April 1 they receive only the old rate of pay and an eight-hour day. Other employees get 10 per cent. increase from Nov. 1, 1902, to April 1, 1903, but after April 1 they go back to the old rate of daily wages, but have a nine-hour day.

Third.—Present methods of payment for coal mined are unchanged.

Fourth.—The commission adjudges and awards: That any difficulty or disagreement arising under this award, either as to its interpretation or application, or in any way growing out of the relations of the employers and employed, which cannot be settled or adjusted by consultation between the Superintendent or Manager of the mine or mines, and the miner or miners directly interested, or is of a scope too large to be so settled or adjusted, shall be referred to a permanent joint committee, to be called a board of conciliation, to consist of six persons, appointed as hereinafter provided. That is to say, if there shall be a division of the whole region into three districts, in each of which there shall exist an organization representing a majority of the mine workers of such district, one of said board of conciliation shall be appointed by each of said organizations, and three other persons shall be appointed by the operators, the operators in each of said districts appointing one person.

The board of conciliation thus constituted, shall take up and consider any question referred to it as aforesaid, hearing both parties to the controversy, and such evidence as may be laid before it by either party; and any award made by a majority of such board of conciliation shall be final and binding on all parties. If, however, the said board is unable to decide any question submitted, or point related thereto, that question or point shall be referred to an umpire, to be appointed, at the request of said board, by one of the Circuit Judges of the Third Judicial Circuit of the United States, whose decision shall be final and binding in the premises.

The membership of said board shall at all times be kept complete, either the operators' or miners' organizations having the right, at any time when a controversy is not pending, to change their representation thereon.

At all hearings before said board the parties may be represented by such person or persons as they may respectively select.

No suspension of work shall take place, by lockout or strike, pending the adjudication of any matter so taken up for adjustment.

Fifth.—Contract miners in any colliery may by majority vote employ and pay the check weighman.

Sixth.—Mine cars must be distributed equitably among the miners. Miners and mine workers must not limit the output or "detract from the quality of the work performed."

Seventh.—Contract miners' pay by the car applies to present cars and toppings—to be increased if size of car or topping is increased.

Eighth.—Sliding scale for all miners and mine workers: Assuming $4.50 a ton as standard tide-water price; 1 per cent. increase in pay for each 5 cents a ton increase in price.

Ninth.—No discrimination by employers and no interference by the union with non-union men.

Tenth.—Contract miners' laborers to be paid by the company and amount deducted from contract miners' pay.

Eleventh.—The awards herein made shall continue in force until March 31, 1906, and that any employee, or group of employees, violating any of the provisions thereof shall be subject to reasonable discipline by the employer; and, further, that the violation of any provision of these awards, either by employer or employees shall not invalidate any of the provisions thereof.

Coal Strike Commission's Comments on Trade Unions.

Of much greater permanent value than the specific awards are the following general statements of the rights and limitations of trade unions extracted from the report of the Anthracite Coal Strike Commission:

The occasion of the strike of 1902 was the demand of the United Mine Workers of America for an increase in wages, a decrease in time and the payment for coal by weight wherever practicable and where then paid by car. The cause lies deeper than the occasion, and is to be found in the desire for the recognition by the operators of the miners' union. . . .

The commission is constrained to decline making an award which would compel an agreement by the operators with the United Mine Workers of America, for however importantly that order may have participated in the strike which was inaugurated on the 12th of May last, and in its subsequent conduct, it is not a party to this submission. . . . It is the striking anthracite mine workers who appear before the commission as the pursuing party. . . . The present constitution of the United Mine Workers of America does not present the most inviting inducements to the operators to enter into contractual relations with it. . . .

The commission agrees that a plan under which all questions of difference between the employer and his employees shall first be considered in conference between the employer or his official representative and a committee chosen by his employees from their own ranks is most likely to produce satisfactory results and harmonious relations, and at such conference the employees should have the right to call to their assistance such representatives or agents as they may choose and to have them recognized as such.

In order to be entitled to such recognition the labor organization or union must give the same recognition to the rights of the employer and of others which it demands for itself and for its members. The worker has the right to quit or to strike in conjunction with his fellows, when by so doing he does not violate a contract made by or for him. He has neither right nor license to destroy or to damage the property of the employer; neither has he any right or license to intimidate or to use violence against the man who chooses to exercise his right to work, nor to interfere with those who do not feel that the union offers the best method for adjusting grievances.

The union must not undertake to assume, or to interfere with, the management of the business of the employer. It should strive to make membership in it so valuable as to attract all who are eligible; but in its efforts to build itself up it must not lose sight of the fact that those who may think differently have certain rights guaranteed them by our free government. However irritating it may be to see a man enjoy benefits to the securing of which he refuses to contribute, either morally or physically or financially, the fact that he has a right to dispose of his personal services as he chooses cannot be ignored. The non-union man assumes the whole responsibility which results from his being such, but his right and privilege of being a non-union man are sanctioned in law and morals. The rights and privileges of non-union men are as sacred to them as the rights and privileges of unionists. The contention that a majority of the employees in an industry, by voluntarily associating themselves in a union, acquire authority over those who do not so associate themselves is untenable.

Those who voluntarily associate themselves believe that in their efforts to improve conditions they are working as much in the interest of the unorganized as in their own, and out of this grows the contention that when a non-union man works during a strike he violates the rights and privileges of those associated in efforts to better the general condition and in aspirations to a higher standard of living. The non-union man who does not believe that the union can accomplish these things insists with equal sincerity that the union destroys his efforts to secure a better standard of living and interferes with his aspirations for improvement. The fallacy of such argument lies in the use of the analogy of State government, under which the minority acquiesces in the rule of the majority; but government is the result of organic law, within the scope of which no other government can assume authority to control the minority. In all acts of government the minority takes part, and when it is defeated the government becomes the agency of all, not simply of the majority.

It should be remembered that the trade union is a voluntary social organization, and, like any other organization, is subordinate to the laws of the land and cannot make rules or regulations in contravention thereof. Yet it at times seeks to set itself up as a separate and distinct governing agency and to control those who have refused to join its ranks and to consent to its government, and to deny to them the personal liberties which are guaranteed to every citizen by the Constitution and laws of the land. The analogy, therefore, is unsound and does not apply. Abraham Lincoln said: "No man is good enough to govern another man without that other's consent." This is as true in trade unions as elsewhere, and not until those which fail to recognize this truth abandon their attitude toward non-union men and follow the suggestion made above—that is, to make their work and their membership so valuable and attractive that all who are eligible to membership will come under their rule—will they secure that firm and constant sympathy of the public which their general purposes seem to demand. . . .

The right to remain at work where others have ceased to work, or to engage anew in work which others have abandoned, is part of the personal liberty of a citizen that can never be surrendered, and every infringement thereof merits, and should receive the stern denouncement of the law. All government implies restraint, and it is not less, but more necessary in self-governed communities, than in others, to compel restraint of the passions of men which make for disorder and lawlessness. Our language is the language of a free people, and fails to furnish any form of speech by which the right of a citizen to work when he pleases, for whom he pleases, and on what terms he pleases, can be successfully denied.

The common sense of our people, as well as the common law, forbids that this right should be assailed with impunity. It is vain to say that the man who remains at work while others cease to work or takes the place of one who has abandoned his work helps to defeat the aspirations of men who seek to obtain better recompense for their labor, and better conditions of life. Approval of the object of a strike or persuasion that its purpose is high and noble, cannot sanction an attempt to destroy the right of others to a different opinion in this respect or to interfere with their conduct in choosing to work upon what terms and at what time and for whom it may please them so to do.

The right thus to work cannot be made to depend upon the approval or disapproval of the personal character and conduct of those who claim to exercise this right. If this were otherwise, then those who remain at work might, if they were in the majority, have both the right and power to prevent others, who choose to cease to work, from so doing.

This all seems too plain for argument. Common sense and common law alike denounce the conduct of those who interfere with this fundamental right of the citizen. The assertion of the right seems trite and commonplace, but that land is blessed where the maxims of liberty are commonplaces.

It also becomes our duty to condemn another less violent, but not less reprehensible, form of attack upon those rights and liberties of the citizen which the public opinion of civilized countries recognizes and protects. The right and liberty to pursue a lawful calling and to lead a peaceable life, free from molestation or attack, concerns the comfort and happiness of all men, and the denial of them means destruction of one of the greatest, if not the greatest, of the benefits which the social organization confers. What is popularly known as the boycott (a word of evil omen and unhappy origin) is a form of coercion by which a combination of many persons seek to work their will upon a single person, or upon a few persons, by compelling others to abstain from social or beneficial business intercourse with such person or persons. Carried to the extent sometimes practiced in aid of a strike, and as was in some instances practiced in connection with the late anthracite strike, it is a cruel weapon of aggression, and its use immoral and antisocial.

To say this is not to deny the legal right of any man or set of men voluntarily to refrain from social intercourse or business relations with any persons whom he or they, with or without good reason, dislike. This may sometimes be unchristian, but it is not illegal. But when it is a concerted purpose of a number of persons not only to abstain themselves from such intercourse, but to render the life of their victim miserable by persuading and intimidating others so to refrain, such purpose is a malicious one, and the concerted attempt to accomplish it is a conspiracy at common law, and merits and should receive the punishment due to such a crime.

The practices which we are condemning, would be outside the pale of civilized war. In civilized warfare, women and children and the denfenceless are safe from attack, and a code of honor controls the parties to such warfare which cries out against the boycott we have in view. Cruel and cowardly are terms not too severe by which to characterize it.

Taylor All-Electric Interlocking.

The following is a partial list, which has been sent to us by the Taylor Signal Company, Buffalo, N. Y., showing the places at which Taylor electric interlocking is to be installed. The list includes all orders which are in course of assembling or erection at the present time.

It will be observed that the capacity of the machines, as shown in the column at the right, is indicated by the number of spaces, not by the number of working levers, which is, of course, less than the capacity of the machines.

Bearing in mind the fact that, until within a year or two, power-operation of switches and signals has been confined almost entirely to large plants, it is of interest to observe that in this list there are nine plants, which have less than 30 levers each and which aggregate only 212 levers, or an average of 23½ levers (spaces) in each cabin.

	Size of machine (spaces).
Sayre, Pa.—Lehigh Valley	32
Relay Depot, E. St. Louis—Terminal R. R. of St. L.	144
N. Market St., St. Louis—St. L. Merchants' Bridge	96
Biddle St., St. Louis—St. L. Merchants' Bridge	40
Mullanphy St., St. Louis—St. L. Merchants' Bridge	36
Madison, Ill.—St. L. Merchants' Bridge	96
Christiana Av., Wilm'gton—Phil., Balt. & Wash. R.R.	36
Limedale, Ind.—Penn. L. W. of Pittsburg	36
Newark, O.—Penn. L. W. of Pittsburg	68
Temple, Texas—A., T. & S. Fe	28
Rockwood, Pa.—Baltimore & O. R. R.	48
Confluence, Pa.—Baltimore & O. R. R.	48
Chicago Terminal—L. S. & M. S. and C., R. I. & P.	192
Waco, Texas—Houston & Texas Central	56
Dallas, Texas—Houston & Texas Central	16
Eureka, Texas—Houston & Texas Central	16
Hearne, Texas—Houston & Texas Central	28
Chaney Junction, Texas—Houston & Texas Central	40
Sherman, Texas—Houston & Texas Central	36
Houston No. 1, Texas—Texas & N. Orleans	68
Houston No. 2, Texas—Texas & N. Orleans	36
Beaumont, Texas—Texas & N. Orleans	36
Bay City, Texas—N. Y., Texas & Mex	24
Rosenberg, Texas—Galveston & S. A.	28
Kankakee, Ill.—Illinois Central	44
Somers, Iowa—Chicago Great Western	32
Moorland, Iowa—Chicago Great Western	20
Dyer, Ind.—Chicago, Indianapolis & Louisville	28
Dorset, Ohio—Lake Shore & Michigan Southern	24
	1,432

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

The United Mine Workers of America do not appear to good advantage under the judicial scrutiny of the Anthracite Coal Strike Commission. It is notable that Mr. Clark, the head of the order of railroad conductors, joins with his fellow members of the Commission in saying that "the cause of the strike lies deeper than the occasion, and is to be found in the desire for the recognition, by the operators, of the miners' union." Also that: "The present constitution of the United Mine Workers of America does not present the most inviting inducements to the operators to enter into contractual relations with it." The Commission recommends that hereafter each company should deal with its own employees only, but that at conferences the employees should have the right to call to their assistance such representatives or agents as they may choose. The awards constitute a three-years' contract, and in their details the demands made are almost unrecognizable. The contract miners have a 10 per cent. increase, but no change in the present method of measurement. The engineers and pumpmen (the classes who were generally faithful and opposed to the strike) have a 15 per cent. increase and an eight-hour day. The other employees have no increase in wages (although they are allowed some extra back pay) but are to have a nine-hour day. Provision is made for a sliding scale of increased wages when coal brings more than $4.50 a ton at tidewater. The Commission estimates the miners' loss of wages during the strike at $25,000,000; the amount expended for relief funds, $1,800,000; the decrease in receipts of the coal-mining companies, $46,000,000; the decrease in freight receipts of the transportation companies, $28,000,000. It is pitiful, and we haven't the heart to add up these figures. The men receive nothing that the companies would not have willingly conceded if they had been permitted to confer directly with committees of their own employees. The six months' war, with its horrors and losses, is plainly due to the unscrupulous agitators, and the Commission's judgment should be their last solemn mass.

Do Trade Unions Help Their Members?

It is significant that the trade unions of the United States, with possibly an exception or two that prove the rule, make no pretense at any endeavor to develop the crafts either by providing for the careful training of apprentices, the promotion of efficient workmanship or the elevation of the intellectual and moral plane of the workingmen. The unions exist for the purpose of driving bargains, for obtaining the greatest pay for the least work. There is the further purpose of a mutual beneficiary association, the payment of sick and death benefits, but this is confessedly an expedient for holding unions together during times of industrial depression when they are powerless to prevent wages from falling. That is, when the supply of labor exceeds the demand wages will fall regardless of any action the unions can take. When a factory that has employed one hundred men has a falling off in orders for a considerable period of fifty per cent., it is obliged to give the one hundred men employment at but half time or to dispense with the services of fifty men. To force it to do otherwise would be to force it into bankruptcy.

The question then arises, to what extent can the action of a union obtain increasing wages in a time of prosperity. When the orders of a factory increase, work at full time is resumed. A further increase of orders means an increase of prices and an increased demand for products, that, affecting correlated industries, quickly extends throughout the manufacturing and commercial organization. At once there is an increased demand for help of all kinds; wages rise, the producers are in competition for workmen, and under the working of economic law, which is as certain as the laws of physics, wages rise to the highest level which the selling prices of the products will allow. This has happened since the industrial revival of 1899, and the trade union leaders have taken all the credit, although the wages of unorganized day labor have advanced in greater proportion than the wages in any branch of organized labor; and the wages of domestic servants, for example, in the vicinity of busy Pittsburg have jumped in the last three years from twenty-five to one hundred per cent., notwithstanding that there is no Union of Hired Girls. This unorganized labor has been liquid, freely moving; organized labor has been made viscid and clotty by the injection of the unassimilable element of the labor demagogue. What the labor leader accomplishes during such a period has been of frequent chronicle during the past three years. He hampers the employer of labor in operations which the community requires, the prosecution of which brings food and clothing to the workmen's family, a result never attained by any trades union activity. He excites unrest and turbulence in his constituents, leading them to demand conditions that are preposterous and wages that cannot be paid. By hampering industrial activity he tends to check industrial progress and to bring a return of industrial depression.

For one example: The plasterers of New York who were being paid $4.50 a day last autumn, an amount that exceeds the average earnings of the professional man, struck for $5.50 a day, with the result that plasterers from all over the country flocked to New York, and the goose of the golden egg was killed.

The trade unions frequently war between themselves, and are then absolutely regardless of either the comfort, the interests or the rights of their employers or of the public as a whole. Because of friction between different unions of carpenters the operations on five buildings in process of construction in Philadelphia were recently suspended. Because of strife between two rival unions of clothing makers which did not involve wages, hours of labor or any other question with their employers, a branch of the tailoring industry of Chicago was forced to undergo total suspension for several weeks at a loss of hundreds of thousands of dollars.

The status and the claims of trades unionism and the foundation therefor were well brought out at a recent meeting of the American Economic Association which had invited both employers of labor and officers of labor unions to participate in a discussion of the trade union question. The secretary of a State federation, a man who for years has been prominent in the councils and the organization of labor, with the manner of a prize ring bully and the voice of a bellowing bull, told that scholarly audience that the shorter hours, higher wages and greater ease workingmen now enjoy were wrested by the coercion of trade unions from grasping and truculent employers, and that the coercion would continue until the workingman regardless of color, or grade or creed would be in the possession of the privileges that are his due by the fact that he lives. This rampant champion was followed by a mild-mannered elderly gentleman, the manager of a widely known New England factory, who said it was quite right the workingman should squeeze from capital all that he could, but that he sometimes tried to squeeze out more than had been put in. The farmer has now a far more comfortable time than when he and his family worked from dawn to dark for mere existence as they did a generation or two ago, but the farmer has not belonged to a trade union. He continued, saying that the operatives in his mill receive from six to eight times the weekly wage of a previous generation, and with that wage can purchase ten times the amount of the product of the mill that they could then. But they had not been "organized" until long after this advance had been largely achieved. The decrease in the burden and enhancement of the ease of living had been caused in greatest degree by the advance in machinery, the improvement in appliance and method that will make further advance possible, but the application of which the trade unions are doing their utmost to prevent.

The following anecdotes, the truth of which can be readily substantiated, afford some further evidence that the attitude of trade unions is not fair either toward the workingmen, the employers, or the public at large.

A professor in a western university, during a recent investigation at first hand, found in the anteroom of a local union in New York a craftsman who ten years before had gone into business for himself, but had lately failed. He then applied to the union to restore him to its ranks that he might find employment, but it was insisted that he bring a card from the union to which he had belonged ten years before. This he could not do because that union had long been disbanded and its records scattered. He was willing to pay multiple the initiation fee of fifty dollars, and there was no blemish upon his record, but in the absence of the impossible card the union allowed him to plead in vain. At a subsequent meeting the professor asked why the man had not been allowed to earn sustenance for himself and his family at the trade at which he was competent. The secretary, shrugging his shoulders, said, "Oh, we don't care for him. You see we have nice work at four dollars a day, and we don't want too many to get in on it."

Not long ago the architect of an office building under way in Pittsburg called the attention of a contractor to the fact that a stairbuilder had placed but two steps during an entire morning, although the material was ready for adjustment when he received it and that six or eight steps a day could reasonably be expected of an ordinarily efficient workman. The contractor replied that although the stairlayers were paid five dollars a day this was their normal performance; that they would not adjust more than four steps a day, and he was powerless in the hands of the union.

During the last fall the superintendent of construction was trying to rush the work on an electric line in Washington to completion before frost. After unsuccessful efforts to increase his force he offered a generous bounty to the men at work to accelerate their speed and work over-time. They scornfully refused to listen and continued to throw down their tools at the stroke of five.

The usefulness of a man in this world is in proportion to his zeal and ability, and the trade union rules aim to repress both of these qualities to the end of equating each workingman's usefulness.

The Railroad Gazette and the Isthmian Canal.

Paris, March 18, 1903.—On the day of final victory, Panama, I remember gratefully the support given to the cause of truth by your most important technical paper and the share you have in the triumph.—BUNAU VARILLA.

This cable message received by the former editor of this journal suggests the propriety of stating very briefly the part borne by the *Railroad Gazette* in the long and hard struggle to have the Isthmian Canal matter settled on a basis of good engineering and sound public policy. Very few people—possibly not a hundred people in the world—realize how important that part was, for the work done was designed and carried on especially with the object of creating correct opinion amongst a comparatively few men who in turn made opinion in a wider field and some of whom originated or influenced legislation. Even Mr. Bunau Varilla, for eight years Chief Engineer of the Panama Canal, and lately active in the affairs of the New Panama Canal Co., knew nothing of our work until it had been going on some years.

In the winter of 1893 a bill was before Congress which provided for the guarantee by the United States of the bonds of the Maritime Canal Company of Nicaragua. Both of the great political parties were committed in their platforms to aid the project of a Nicaragua Canal. The daily newspapers of the whole country, almost without exception, took it for granted that if a canal were to be built it should be on the Nicaragua route and on the plans and estimates of the Maritime Canal Company. Such opposition as existed was on the broad question of canal or no canal. The danger was very great that the nation would be plunged blindfolded into a gigantic mistake, involving the expenditure of some

hundreds of millions, and a mistake which could never be corrected.

In January of that year we printed an editorial article setting forth, without heat or prejudice, a few facts that were known, and calling attention to the insufficiency of any man's knowledge for a reasonable judgment on this great question. We showed that the cross sections proposed by the canal company, on which their estimates of time and cost were based were inadequate and dangerous for ships then afloat and impossible for ships then building. We showed that the cross section in rock cut was less than one-half of the original cross section of the Suez Canal, and less than one-third of the cross section to which the Suez Canal had been enlarged, and that the proposed cross section in earth cut was less than one-half of that of the Suez Canal. We pointed out the colossal size and unprecedented character of some of the engineering works to be done, and the superficial studies and incomplete designs that had been made for them. We showed that the rainfall to be provided for had not been determined by observations and had, without doubt, been underestimated by the engineers and promoters of the company. Finally we suggested that the Government send a commission of engineers to examine and report before the country should guarantee the bonds of the canal company. This editorial article was put in the hands of editors and members of Congress; the scheme was no longer taken for granted; the bill failed.

Naturally, the *Railroad Gazette* was sharply attacked from many quarters, but the attacks only served our purpose by spreading in the public mind the "reasonable doubt" which we had sought to create. It was often said that we were opposing the canal in the interest of the railroads. To this we answered (1) that if the canal should do half what its friends thought it would do, it would be a grand thing for the railroads, for it would create a new and profitable short-haul business on both coasts, and would take away only the least profitable of the long haul business, and (2) that we did not oppose an Isthmian canal, but did oppose the effort to commit the nation to an enterprise the cost of which was unknown and could not be even approximately estimated. At that time the chief engineer of the canal company guessed that the canal would cost $66,466,880. A board chosen by the company raised this to $87,799,570. The reader will perhaps remember that the Walker Commission raised this estimate to $189,864,062; but this is getting ahead of our story.

In the session of 1894 a bill was brought in to guarantee the bonds for $70,000,000; and to appoint a Government commission. Again we took a hand in. By this time a large opposition had grown up against the determined effort to help the company out of its difficulties by the credit of the country, and the bill was easily defeated.

At length, after repeated defeats of the so-called "friends" of the canal, who long opposed every attempt to get a commission without a guarantee hitched to it, and who used great energy and ingenuity, an independent commission was appointed who reported (Feb., 1896) that perhaps the Nicaragua Canal could be built for $133,000,000; but that the whole subject should be studied for 18 months, at an estimated cost of $350,000, before any trustworthy figures could be laid down.

For many months the officers of the Nicaragua company tried to break down and discredit the report of this (the Ludlow) commission and resisted every effort to have the further studies authorized. In 1897 the first Walker commission was appointed and made further studies, and finally, in June, 1899, the Isthmian Canal Commission (which still exists) was appointed, with instructions to go over the whole field, and with $1,000,000 to spend in studies. Then followed the recent train of events which led at last to the purchase of the Panama Canal and the treaty with Colombia.

The struggle which went on for ten years was full of complications which cannot be even hinted at in an article so brief as this must be, and some of the episodes were even dramatic. The fight of the Nicaragua people was at the bottom a fight for a fortune, but enlisted in it were many honest and patriotic men who were misled. As knowledge accumulated, what we had long thought probable became evident, viz.: that the Panama route was much the better one, and then our efforts, which had so long been directed toward the accumulation of this knowledge were turned toward the adoption of the Panama route.

At the beginning of this ten-year fight the *Railroad Gazette* stood entirely alone in the technical press and practically without support from the daily press. Help came very quickly from the most intelligent and responsible daily papers; but it was some years before the engineering journals dared take a hand in, and up to the end, their writing had little of knowledge or courage or vigor. It was a quite remarkable instance of a lone fight; it is not often that a man or a journal has the chance to make such a fight, and still less often do the chance, the sight to see and the energy to act come together.

We think it proper to put on record this honorable event in the history of the *Railroad Gazette*, especially as Col. H. G. Prout, who saw the opportunity and did the work, no longer controls this page. It is perhaps too much to assume that the monumental commercial and engineering blunder of building a canal on the Nicaragua route would have been committed but for Prout's activity; but it would surely have been committed if he, or some one else, had not done just what he did.

High Capacity Cars in England.

"As to the long freight cars used in America, the important factor is not the length, but the carrying capacity of the car in relation to its weight. American freight cars are all carried on bogies (4-wheel trucks) and their carrying capacity varies from 30 to 50 tons, and their tare weight from 15 to 20 tons. . . . So long as these proportions are adhered to, it makes no difference, so far as the cost of transportation is concerned, whether the load is carried in one car with eight wheels or in two cars with four wheels each. That is to say, the result will be the same if, instead of one car of the size and weight mentioned, two cars are employed, each with a capacity of 25 tons and a tare of 10 tons, and each having 4 wheels." —This is quoted from Colonel Yorke's report to the British Board of Trade.

It well may be that under the present limitations of clearance and track arrangements on English roads the use of heavy cars such as those is well nigh impossible. Much of the criticism of English managements is unjust and their failure to generally adopt the high capacity car has, in a measure, been due to the limits fixed by the size of bridges, tunnels and inter-rail space which was adopted in Stephenson's time, and which cannot well be altered. The extreme width of engines and cars in England cannot exceed 8 ft. 6 in., as compared with 10 ft. 6 in. in this country and the height in England is limited to 13 ft., as compared with 16 ft. in America.

We cannot agree with the statement that the economy of the 25-ton car is the same as that of the 50-ton car provided the ratios of tare to loaded weight are the same in both cases. The use of the high capacity car in America is the development of a systematic study of the factors which affect the cost of hauling one ton one mile, and ton-mile statistics show, that within limits, the cost bears some inverse relation to the tonnage hauled per train. Evidently, if train lengths are not to be excessive, the use of the heavy car is necessary in order that maximum efficiency be attained.

Most 50-ton capacity cars in this country have hopper bottoms and are used in carrying coal, iron and other materials which can be unloaded by gravity. The cost of handling at both ends is in almost direct proportion to the number of cars handled—a material economy credited to the high capacity car. Experiments have demonstrated that the train resistance in pounds per ton is greater for the low capacity car than for the heavier car. We have in mind tests made at speeds between 17 and 25 miles an hour in which the resistance per ton for a 20-ton car was about 5 pounds while for an 80-ton car the resistance dropped to 2 pounds per ton. The number of wheels under a car should have little effect upon the resistance while, on the other hand, with the smaller car and the greater number required for a given load, the surface exposed to the action of the wind is materially increased. Perhaps wind resistance is unimportant in England, but in America it happens trains are stalled by heavy side winds. Futhermore, the first cost of two 25-ton cars is greater than that of one 50-ton car, which calls for a greater capital investment if the former type is to be used in handling a given amount of business. There is some saving in the first cost of a four-wheel car due to the simpler construction of the running gear, but two cars of 25 tons each require two sets of air brake apparatus, couplers, etc., as against one set of each for the single 50-ton car. The number of parts to be handled and the consequent increase in the cost are evidently matters which are unfavorable to the small cars. Roughly speaking, the cost of two 25-ton 4-wheel cars is about 25 per cent. greater than the cost of one 50-ton 8-wheel car of similar general design. The cost of maintenance and repairs is likewise increased.

That the economy of the heavy car is appreciated in England and that the views of Col. Yorke are not altogether representative, is indicated by a recent order for fifty 40-ton capacity steel bogie cars given by the North Eastern to the Leeds Forge Company. These cars have hopper bottoms and are in many respects radical departures from English practice. To quote from an English contemporary the order was given "with a view to effecting economies in the working of its (the North Eastern's) coal-shipment traffic."

Chicago, St. Paul, Minneapolis & Omaha.

Although the number of tons of freight carried in 1902 increased 286,069, the average freight haul decreased from 162 to 158 miles, and the average number of tons carried per train, per mile, decreased 12 tons, or 5.09 per cent. The number of passengers carried increased 17.7 per cent.; number carried one mile increased 16.8 per cent., and the total passenger revenue was $438,765 larger, or 13.98 per cent. Charges to maintenance of way and structures decreased $60,925, and charges to equipment, $14,555; but charges to conducting transportation increased $532,938, owing to the higher cost of fuel for locomotives, and to a large increase in the salaries of engineers and firemen and switchmen. Total operating expenses were $7,483,254, an increase of $468,983. Gross earnings increased $711,121, from $11,196,404 to $11,907,525, but the ratio of operating expenses to earnings remained practically the same, or about 63 per cent. Net earnings showed an increase of $232,138, and, despite the increase in dividends on the common stock, from 5 to 6 per cent., amounting to $185,550, and the deduction of $600,000 for future betterments and improvements, the surplus was $417,060, as against $413,524 in 1901. The funded debt was increased $454,528 by the issue of that amount of consolidated mortgage bonds, on the 36 miles of the Minnesota & Wisconsin Railroad, which was acquired during the year. The increase in mileage worked is due to the building of four branch lines, aggregating 66.9 miles, the total number of miles worked Dec. 31, 1902, being 1,657. Statistics of operation follow:

	1902.	1901.
Freight earnings	$8,159,226	$7,913,796
Passenger earnings	$3,137,708	$2,698,943
Average miles operated	1,604	1,574
Ton miles	849,645,417	823,144,727
Passenger miles	136,076,411	116,432,512

Texas & Pacific.

The results for the year ending Dec. 31, 1902, are less favorable than for the preceding year, and show general decreases in gross and net earnings. There were slight gains in the passenger traffic, but these were not sufficient to offset the losses in freight revenue occasioned by poor crops in Texas during 1902, succeeding a previous year when the production of cereals was very limited. The unusually heavy floods during the closing months of the year seriously interrupted the movement of trains, and affected earnings to a considerable extent. It must be borne in mind, however, that earnings in 1901, both gross and net, were considerably larger than ever before in the history of the company.

Gross earnings in 1902 were $11,236,601, as against $11,769,942, in 1901, and earnings per mile of road, $6,621, as compared with $7,203. The report is exceptional, however, in showing a decrease in working expenses, in the face of the general increase in cost of production throughout the country, so that net earnings, which were $3,484,311 during the year, decreased but $251,180, as against a decrease of $629,767 in gross. An analysis of the cost of conducting transportation throughout the two years shows important decreases for 1902 in fuel, wages of engine and roundhouse men, train service and car mileage, besides minor savings, so that expenses thus accounted were $104,532 less last year than in 1901. The balance of the comparative gain in net, however, was occasioned by the fact that the charge to maintenance of way was more than usually limited to renewals, and betterments of a permanent character were charged direct against surplus income, under the heading of improvement and equipment account. The amount spent and thus charged off during 1902 was $2,207,358, and this, in connection with the dividend on the income bonds, resulted in a nominal deficit of $148,819, to be deducted from the total receipts as a prior charge to working expenses. Maintenance of way, exclusive of the special fund, figures out at about $945 per mile of road owned, however.

The credit balance forward is $1,569,284, as against $3,220,439 last year, and the dividend on the $25,000,000 income 5s is a charge against this "to the extent that the yearly net earnings will permit," non-cumulative.

The statistics for 1902 show a slight decrease, both in carload and in trainload, the average number of loaded cars in each train remaining the same as in 1901, 15 cars. It is rather surprising that the average number of loaded cars in a train has remained practically unchanged during 10 years and has actually fallen off a fraction from the figure given in 1894. Average carload increased from 10.13 tons in 1893 to 12.99 in 1901, and fell off slightly, to 12.71, last year. It is likely that the large purchases of new equipment which have recently been made, and the general improvement to

the line, will permit of a better trainload in subsequent years.

During 1902 2,500 new box cars were added to the rolling stock, besides about 700 cars built at the company's shops; 32 locomotives were purchased, and four were built. For maintenance of equipment $1,410,593 was spent, as against $1,392,353 in 1901.

Work on the new branch lines in Louisiana was retarded by a continuance of wet weather and by scarcity of labor, but 59 miles were completed ready for operation, including a large drawbridge over the Red River, which will permit of extension of the line to a connection with the New Orleans & Northwestern, at Concordia, La. A cutoff on the Eastern Division, from Texarkana to the Sulphur River, eight miles, was also completed, reducing the main line mileage by nearly that amount, and making a considerable improvement in grade and curvature. The physical condition of the property was also much improved by a liberal expenditure for heavy rails and for ballast, to meet the requirements of increasing business, particularly on the New Orleans Division.

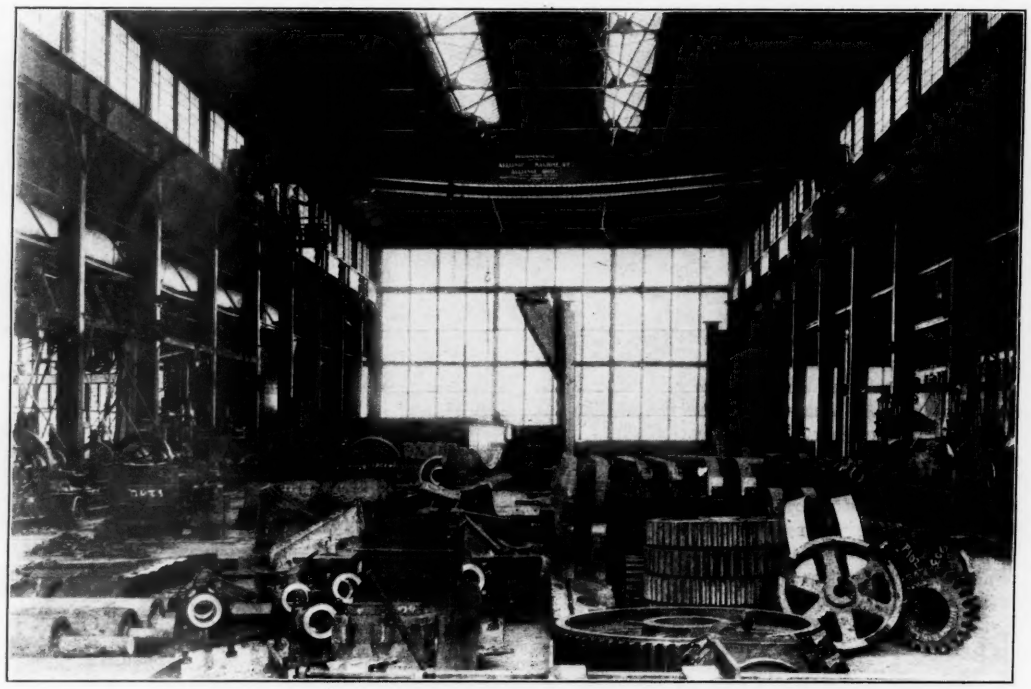
The United States Supreme Court has decided that the railroad commission of Arkansas cannot fix rates for transportation of goods between two points within the State, where a large part of the route is outside of the State, in Indian Territory or Texas. This is the substance of a decision by Mr. Justice Holmes which has just been published. Chairman Knapp, of the Interstate Commerce Commission, says that it will settle a number of controversies. The road interested is the Kansas City Southern, the line of which runs from a point in Missouri over the soil of Arkansas for 28 miles, then 128 miles in Indian Territory, then over 117 miles in Arkansas, and then into Texas. The railroad gets its title in the Indian Territory from an act of Congress, in which Congress expressly reserves the right to at all times fix rates whenever transportation shall extend from one State into another, or shall extend into more than one State, but this does not seem to be a ruling condition in the present suit. The decision says that the transportation of the goods on which the suit is based was, in its aspect of commerce, not confined within the State. "No one contends that the function of State regulation could be split up according to the jurisdiction of State or territory over the track, or that both State and territory may regulate the whole rate. There can be but one rate, fixed by one authority, whether that authority be Arkansas or Congress. . . . It would be more logical to allow a division according to the jurisdiction over the track than to declare that the subject of regulation is indivisible, yet that the indivisibility does not depend upon the commerce being under the authority of Congress, but upon a fiction which attributes it wholly to Arkansas, although that fiction is quite beyond the power of Arkansas to enforce." Judge Holmes quotes with approval a decision of Judge Field in the cases of Lord vs. Goodell and Pacific Coast S. S. Co. vs. Railroad Commissioners, where it was held that navigation on the high seas, between ports of the same State, is subject to regulation by Congress. The case of the Lehigh Valley Railroad vs. the State of Pennsylvania (145 U. S. 192) was a suit concerning the imposition of a tax by the State, and was distinguished expressly from an attempt by a State directly to regulate transportation outside its borders. This Lehigh Valley case has been, since 1892, the precedent for numerous decisions which Justice Holmes now practically overthrows. It was, says the Justice, carefully confined to the question of taxation, and, moreover, the tax was determined in respect of receipts for the portion of the transportation within the State. Such a tax had before that been sustained in the case of commerce admitted to be interstate. The present decision, it will be observed, puts an end to the question of whether the New York State Railroad Commission has jurisdiction over grain rates from Buffalo to New York over such lines as the Lehigh Valley, the Erie and the Delaware, Lackawanna & Western, which for a part of the distance traverses Pennsylvania and New Jersey. Until quite recently, and possibly even now, the railroads between these two cities maintained what was practically a pool of grain traffic, the Federal anti-pooling law being held inapplicable to the situation.

An estimate of the production of cars in the United States during 1902 was printed in our issue of Dec. 26. The figures published at that time were obtained direct from the builders, and showed that the total output, exclusive of electric cars and those built in railroad shops, was 164,547 cars. Subsequent inquiries give 24,721 as the number built of steel throughout, making the proportion of steel cars 15 per cent. of the total. In 1901, out of a total of 144,267, the number built of steel throughout was 22,288, which also figures to 15 per cent. of the total, although 2,433 more steel cars were built in 1902 than in 1901.

"More Trouble Brewing; New Haven Freight Handlers Demand Higher Pay." This is the heading of a news item in the New York *Tribune* of March 19. It was at the time when negotiations were pending between the officers of the New Haven road and representatives of conductors, brakemen and firemen who are asking for an increase in wages, and the freight handlers, to use the mild language of President Hall, "seem to think that such a time is the most favorable opportunity for them to come forward and get all they can." This action of these New Haven employees is in marked contrast to that of a committee of enginemen on the Central of New Jersey, who, a few weeks ago, were asking for modifications in their wages or regulations, and whose application was pending at the time of the disastrous collision at Westfield. The next day after that collision, an occurrence necessarily throwing a mountain of work on the officers of the road, the representatives of the enginemen, Arthur Kirkendal and Martin Dubbs, called on the General Superintendent and requested him to lay their matter aside indefinitely.

The Alliance Machine Company.

This company's plant at Alliance, Ohio, for making electric traveling cranes, special electrically operated machines, rolling mill and special machinery, hydraulic riveters, flangers, punches and presses, was completed last June. It consists of a well-lighted building, 330 x 123 ft., and was built by the Penn Bridge Co. The interior of one end of this building, shown herewith, indicates the general features of construction, and particularly the excellent lighting by means of skylights and liberal glazing of the side and end walls. It is a three-bay building, of steel, the side and end walls being brick to the height of the window sills, and around the door openings. Above the brick the walls are entirely of steel and glass. Spanning the central bay and traveling the length of the shop is an electric crane of the company's design, having a main hoist of 60,000 lbs. capacity, and an auxiliary hoist of 10,000 lbs.



Shop of Alliance Machine Co., Alliance, Ohio.

Up to the present time some 60 cranes of different capacities have been turned out of this shop. They have ranged from 10 tons to 125 tons capacity, and have been supplied to the Carnegie Steel Co., Bethlehem Steel Co., Colorado Fuel & Iron Co., Jones & Laughlin Steel Co., American Steel & Wire Co., Pennsylvania Steel Co., etc.

Among these cranes was one of 90 tons capacity with 30-ton auxiliary hoist for the Bethlehem Steel Co., and a 75-ton ladle crane with two 25-ton auxiliary hoists and 81 ft. 6 in. span girders, which alone weigh 60 tons, for the Carnegie Steel Co. The Canadian Pacific has ordered two 60-ton cranes; one 15-ton, and one 10-ton crane, for its new locomotive erecting shop which is being built at Montreal, Can.

Equated Tonnage Rating—Methods of Test and Calculation.*

The work of engine rating consists of two main divisions; first, to determine the maximum working tractive force of the engine, and second, to balance this with an equal amount of total train resistance on the ruling grade.

Tractive Force.

For fixing the maximum tractive force that an engine may develop at the tender drawbar on level track for simple engines, the following formula was used:

$$T F = \frac{.85 P d^2 s}{D}$$

Where P equals maximum boiler pressure in lbs. per sq. in.
d equals diameter of cylinder in inches.
s equals stroke in inches.
D equals diameter of driver in inches.

This formula assumes that the mean effective pressure in the cylinders at full stroke is 92 per cent. of the maximum boiler pressure and that 92 per cent. of the work done by the cylinders is transmitted back to the drawbar behind the tender.

*Abstract of a paper presented to the Western Railway Club, March 17, 1903, by Mr. M. H. Wickhorst, Engineer of Tests, C., B. & Q. R. R., Aurora, Ill.

For compound engines the following formula was used, working compound:

$$\text{Two-cylinder compounds, } T F = \frac{.85 P d_l^2 s}{D (r + 1)}$$

$$\text{Four-cylinder compounds, } T F = \frac{1.7 P d_l^2 s}{D (r + 1)}$$

$$\text{Two-cylinder componnds working simple, } T F = \frac{.85 P d_l^2 s}{D}$$

Where d_l = diameter of low pressure cylinder.
d_h = diameter of high pressure cylinder.
r = ratio of cylinder volumes.

The only four cylinder compounds that we have are of the Vauclain type, and when worked so-called "simple" they work compound as before, but in addition a small amount of steam is let direct into the low-pressure cylinder, which has the effect of increasing the tractive force an amount depending on the speed. At speeds of 10 miles per hour this increase amounts to about 2,000 lbs., according to one or two trials we made.

Tractive Force on Grade.

On a grade the tractive force of an engine is less, due to the fact that it must lift its own weight up the hill, which absorbs some of the work performed by the cylinders and leaves less to develop at the drawbar. The amount to be deducted for this engine grade resistance is found by the following formula:

Engine Grade Resistance = 20 W G;
Where W = weight of engine and tender in tons;
G = grade in per cent.

Working Tractive Force.

Having obtained the maximum tractive force, a certain allowance must be made for small drops in steam pressure, and for an occasional stuck brake, excess of billed over actual tonnage, etc., which affect the train resistance. On runs where the maximum grade is only a small portion of the total distance, and the run comparatively light, we took 90 per cent. of the maximum available tractive force as the maximum working tractive force on the ruling grade, thus allowing 10 per cent. for the above mentioned contingencies. With a slow freight train under these conditions the minimum speed would be about eight or ten miles per hour. Where the run as a whole is hard and the grades long, we took 80 per cent. This would allow the engine to handle the train conveniently on the ruling grade and yet not have a great excess of tractive force to spare. For convenience in making rate schedules and calculating, we have made a table showing the maximum available tractive force of an engine on the level; 90 per cent. and 80 per cent. of this; and also these three with the engine grade resistance subtracted for grades from 0.1 per cent. to 3 per cent.

Train Resistance.

Train resistance consists of three primary resistances as follows: (1.) Acceleration resistance. (2.) Grade resistance. (3.) Friction.

Acceleration and grade resistance are elementary resistances, dependent only upon the amount of tonnage and not upon the form of the tonnage, such as in empty or loaded cars, etc. Friction is a compound resistance dependent upon a good many conditions, such as kind of cars, load in cars, condition of track, condition of trucks, wind, curves, etc. In rating slow freight trains acceleration resistance need very seldom be considered, except on momentum grades. Here it comes in as negative resistance and will be considered later under the head of momentum grades.

Grade Resistance.

This, generally, is the biggest component of the freight train resistance and is dependent only on the tonnage on

any given grade. The grade resistance per ton may be figured by the following formula:

$$r_g = 20\ G$$

Where

r_g = grade resistance in lbs. per ton

G = grade in per cent.

Friction.

As stated above the frictional resistance varies considerably. The friction expressed in pounds per ton of drawbar pull increases as the speed increases, decreases as the gross weight of a car and its freight increases, and increases in a general way as the temperature of the air decreases. It varies for freight cars at freight speed between limits of about 2 lbs. per ton and 12 or more lbs. per ton. Fig. 1 shows some curves of friction resistance of freight cars at speeds of 20 m.p.h. These curves show the relation between the gross weight per car in tons, plotted horizontally, and the resistance per ton in pounds, plotted vertically, for three weather conditions.

The curve showing resistance of freight cars in summer weather is the result of dynamometer tests by the Pennsylvania, and various results obtained by us fall in well with this curve. It will be noted that according to these results the friction resistance of an empty car weighing 15 tons is 6.2 lbs. per ton, while that of a loaded car weighing 60 tons gross is 2.4 lbs. per ton.

The curve showing friction of freight cars in cold weather, say 20 deg. F. above zero, is one obtained by us in some dynamometer tests last winter. In this case it will be noted the friction resistance for the 15-ton car is 10 lbs. per ton, and of the 60-ton car is 5 lbs. per ton. The curve we show for very cold weather is obtained from the last one by arbitrarily adding 2 lbs. per ton all along.

Knowing the grade, the gross weight of a car and the general weather condition, its total resistance per ton is found by adding together the grade and friction resistances per ton as found from the above-mentioned curves.

Equated Tonnage Tables.

Having the total resistance per ton of any given train and the maximum working tractive force of the engine, the thing is now to get sufficient tons to just make total train resistance to balance this tractive force. The number of tons that will give this total resistance will, of course, vary with the load per car and the weather conditions, increasing as the load per car increases and decreasing as the weather conditions become more severe. For practical use we get up a rate table showing the number of tons for various numbers of cars in the train and for three weather conditions, namely: Summer, winter, and very cold.

The method in detail of obtaining these tables is shown in table 1. We have made such tables for grades up to 2 per cent., and for total train resistances from 10,000 lbs. to 35,000 lbs., making several hundred tables. When, therefore, we have decided on the maximum working tractive force on a given grade, we simply select from the set of tables the suitable schedule and give this as the tonnage rate schedule for the engine.

Momentum Grades.

For our purpose the simplest method is to express momentum as so much negative grade, and its value may be figured by the following formula:

$$G_m = 3.5\ \frac{V^2}{x}$$

Where G_m = equivalent grade in per cent.

V = speed in miles per hour.

x = distance traversed during retardation, in feet.

Where a minimum speed of five miles per hour at top of grade is assumed, the equivalent grade would be determined as follows:

$$G_m = 3.5\ \frac{V^2 - 25}{x}$$

From Fig. 2 can readily be obtained the equivalent grade in per cent., having the speed of approach and length of grade, based on this formula. Having the actual grade, and the momentum expressed as equivalent grade, the virtual grade is equal to the actual minus the momentum. The actual resistance of the train is, then, that due to the virtual grade plus the friction.

Tractive Force at Speed.

Where the speed is above eight or ten miles per hour, the maximum tractive force cannot be sustained on account of the inability of the boiler to furnish sufficient steam, and when calculating tonnage rates on momentum grades, it is necessary to determine the average tractive force from the bottom to the top of the hill. The tractive force as limited by the boiler is obtained by the following formula:

$$\text{Tractive force} = \frac{375 \times .43\ H \times E}{S}$$

Where H equals heating surface in square feet.

S equals speed in miles per hour.

E equals mechanical efficiency of the locomotive; that is, the ratio of the drawbar pull to the cylinder tractive force.

The expression .43 H gives the maximum cylinder horse-power of the locomotive, assuming a maximum evaporation of 12 lbs. of water per sq. ft. of heating surface per hour and a cylinder water rate of 28 lbs. of water per h.p.h. This is a formula given by Prof. W. F. M. Goss,* and agrees well with the results of our locomotive tests. The expression

$$\frac{375 \times .43\ H}{S}$$

converts horse-power into cylinder tractive force. The value of E, or the mechanical efficiency of the locomotive as a whole, is dependent upon the speed, decreasing as the speed increases. It is obtained from Fig. 3, which gives efficiency curves obtained from extensive road tests.

The tractive force shown on the above-mentioned curves, at the average speed will generally be found satisfactory. We have also adopted the rule that where a grade is less than one mile long, not over 1 per cent. and the speed of approach over 35 m.p.h., to figure it as a momentum grade. Where the speed of approach is much greater it would allow a steeper or a longer grade to be figured as a momentum grade.

Equated Tonnage Tables.

The figures on table 1 show the method used in calculating equated tonnage tables. The various tonnages shown all have the same drawbar resistance of 20,000 lbs., and are calculated for a 0.5 per cent. grade at freight speeds of 20 m.p.h. The method is to make a column of gross car weights from 10 tons to 60 tons, column 1. In column 2 is then shown the resistance per ton of cars of the various gross weights. This includes the grade and friction resistance per ton. Next divide 20,000 by the resistance per ton and get column 3, showing the various tonnages having the total train resistance of 20,000 lbs. Then by dividing the number of tons by the gross weight per car gives column 4, showing the number of cars in the train corresponding to the various tonnages. The columns of tons are then interpolated to the nearest even figure divisible by 5 and corresponding to an even number of cars divisible by 5 and placed in column 16, which is the column as finally used in rate schedules.

Having column 16, the columns 5 to 14 inclusive are obtained from columns 15 and 16 by multiplying by a suitable factor. For example columns A are slow freight rates, columns B fast freight rates, and we have taken for general use the fast rates as 80 per cent. of the slow rates. To get the tons, column 5, multiply the tons in column 16 by .80, and to get the cars in column 6, multiply column 15 by .80. The tons thus obtained in column 5 are in turn placed in column 17, interpolating to some even figure as before. The other columns 7 to 14 inclusive are obtained in a similar manner by using a suitable factor, selected from table No. 2.

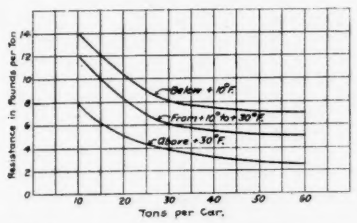


Fig. 1.—Relation Between Resistance Per Ton and Tons Per Car.

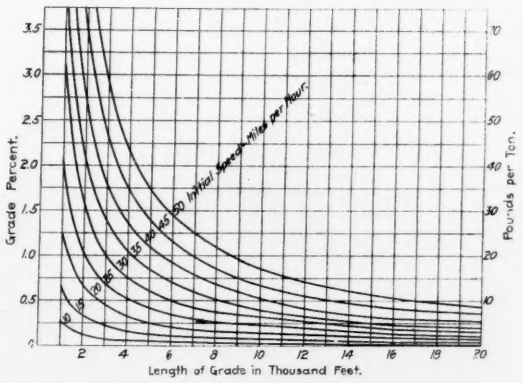


Fig. 2.—Momentum Grades—Initial Speed Required for Minimum of Five Miles an Hour at Top of Grade.

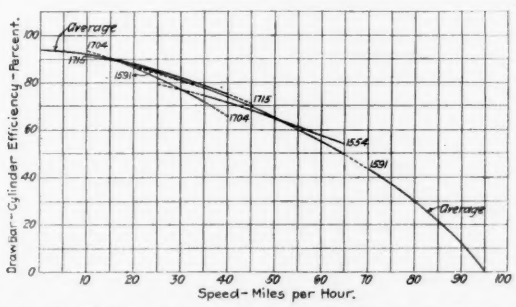


Fig. 3.—Relation Between Drawbar and Cylinder Power.

Table No. 2.—Ratio of Tons and Cars, with Summer Weather Taken as 100.

	+ 30° to + 10° F.		Below + 10° F.	
	A	B	A	B
Grade.	TW	TW x .8	TW	TW x .8
Per cent.	TC	TC	TV	TV
.0	.61	.49	.48	.38
.1	.68	.54	.56	.45
.2	.74	.59	.63	.50
.3	.77	.62	.67	.54
.4	.81	.65	.71	.57
.5	.83	.66	.74	.59
.6	.84	.67	.76	.61
.7	.85	.68	.78	.62
.8	.86	.69	.80	.64
.9	.87	.70	.82	.66
1.0	.88	.70	.83	.66
1.1	.89	.71	.84	.67
1.2	.90	.72	.85	.68
1.25	.90	.72	.85	.68
1.3	.90	.72	.86	.69
1.4	.91	.73	.87	.70
1.5	.91	.73	.87	.70
1.6	.92	.74	.88	.71
1.7	.92	.74	.88	.71
1.8	.92	.74	.89	.71
1.9	.93	.74	.90	.72
2.0	.93	.74	.90	.72

NOTE.—TW—Resistance per ton for warm weather, above 30° F. TC—Resistance per ton for cold weather, from 30° to 10° F. TV—Resistance per ton for very cold weather, below 10° F.

Foreign Railroad Notes.

The Japanese Government, according to Tokio despatches, is about to issue 17,000,000 yen (about $8,500,000) of railroad bonds, the amount required for the construction work decided upon last year, which was postponed.

When the Paris underground railroad system is completed, there will be under the place de l'Opera three tunnels on different grades, one under the other, to avoid grade crossings. The masonry extends 69 ft. below the surface, nearly half the distance below water level. The pavement will be supported by iron girders over the upper tunnel.

The German railroad in southwest Africa is not exactly a mine of wealth as yet. It is 212 miles long from the coast at Swakopmund to Windhock, and was opened for traffic its entire length July 1, 1902. For the current year the earnings are estimated at $223,282, and the expenses at $66,376 more. A locomotive is able to haul on the easiest grades five cars loaded with 11,000 lbs. each. But on the steepest grade two engines coupled together can haul only two such cars. The engines carry water enough for a run of no more than 10 miles, and a tank car must be hauled to provide water. The road is of 2-ft. gage.

The Usambara Railroad in German East Africa, 52 miles, has also a balance on the wrong side; the expenses have been 220 per cent. of the gross earnings. Its freight traffic averaged about 10 tons daily, and its gross earnings were about $450 per mile. This railroad is not far

TABLE NO. 1.—EQUATED TONNAGE RATING: GRADE, .5 PER CENT.; RESISTANCE, 20,000 LBS.

	Tons per car.	Friction and grade resistance per ton.	Temperatures. Above + 30° A Tons.	A Cars.	B Tons.	B Cars.	+ 30° to + 10° A Tons.	A Cars.	B Tons.	B Cars.	Below + 10° A Tons.	A Cars.	B Tons.	B Cars.	Cars.	Temperatures. Above + 30° A	B	+ 30° to + 10° A	B	Below + 10° A	B
a	10	17.9	1117.	111.7	900.	88.	930.	91.5	740.	72.5	832.	81.5	665.	65.	100	1160	....	....	....	....	..
b	11	17.5	1143.	103.8	930.	80.	960.	83.	765.	66.	860.	74.0	685.	59.	95	1180	....	....	....	....	..
c	12	17.1	1170.	97.4	945.	76.	980.	78.8	780.	62.5	875.	70.	695.	56.	90	1200	....	935	....	....	..
d	14	16.5	1212.	86.6	960.	72.	995.	74.6	790.	59.5	890.	66.5	710.	53.2	85	1220	....	950	....	....	..
e	16	15.9	1257.	78.6	975.	68.	1010.	70.6	805.	56.	905.	63.	720.	50.2	80	1245	....	970	....	835	..
f	18	15.5	1290.	71.7	995.	64.	1033.	66.4	820.	54.	920.	59.2	735.	47.3	75	1270	950	990	....	855	..
g	20	15.1	1324.	66.2	1015.	60.	1053.	62.2	840.	49.5	940.	55.5	750.	44.4	70	1300	970	1010	750	875	..
h	25	14.4	1389.	55.6	1040.	56.	1080.	58.1	860.	46.	960.	52.	770.	41.4	65	1330	990	1035	770	895	665
i	30	13.9	1439.	48.0	1060.	52.	1105.	53.9	880.	43.	985.	48.	785.	38.4	60	1360	1015	1060	790	920	680
j	40	13.2	1514.	37.9	1090.	48.	1130.	49.8	900.	39.5	1005.	44.4	805.	35.4	55	1395	1045	1090	815	945	700
k	50	12.8	1565.	31.3	1110.	44.	1160.	45.6	920.	36.5	1030.	40.7	825.	32.5	50	1430	1075	1125	840	970	720
l	60	12.5	1600.	26.7	1145.	40.	1185.	41.5	945.	33.	1060.	37.	845.	29.5	45	1465	1140	1160	870	1000	745
m	..	..	....	..	1175.	36.	1215.	37.4	970.	29.5	1085.	33.4	865.	26.5	40	1500	1145	1195	900	1030	775
n	..	..	....	..	1200.	32.	1245.	33.2	990.	25.5	1110.	29.6	885.	23.6	35	1535	1180	1230	935	1070	805
o	..	..	....	..	1230.	28.	1275.	29.	1010.	23.	1135.	25.8	905.	20.7	30	1575	1215	1270	970	1110	835
p	..	..	....	..	1260.	24.	1305.	24.5	1040.	19.8	1165.	22.2	930.	17.7	25	1615	1250	1310	1005	1150	870
q	..	..	....	..	1290.	20.	1340.	20.7	1065.	16.5	1195.	18.5	950.	14.8	20	....	1290	1350	1040	1190	910
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

*See *Railroad Gazette*, Jan. 17, 1902, p. 38.

south of the British Uganda Railroad, and those interested in the colony wish to have it extended to Mt. Kilimandjaro.

An Improvement in Planing Machines.

To produce the highest quality of finished lumber from a planing machine by matching, after both sides of the stock have been finished, it is necessary to have the stock accurately planed. This may be accomplished by taking the top cut first and providing a rigid platen, or bed, for the stock to rest upon while the cut is being removed. The accompanying engravings of the Woods' adjustable wedge platen show a device which overcomes the difficulties usually found in attempting to produce finished lumber by the method mentioned. The problem becomes

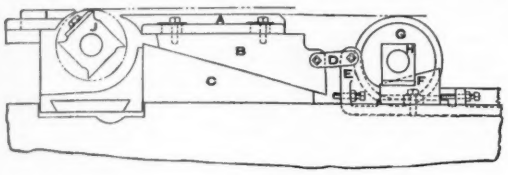
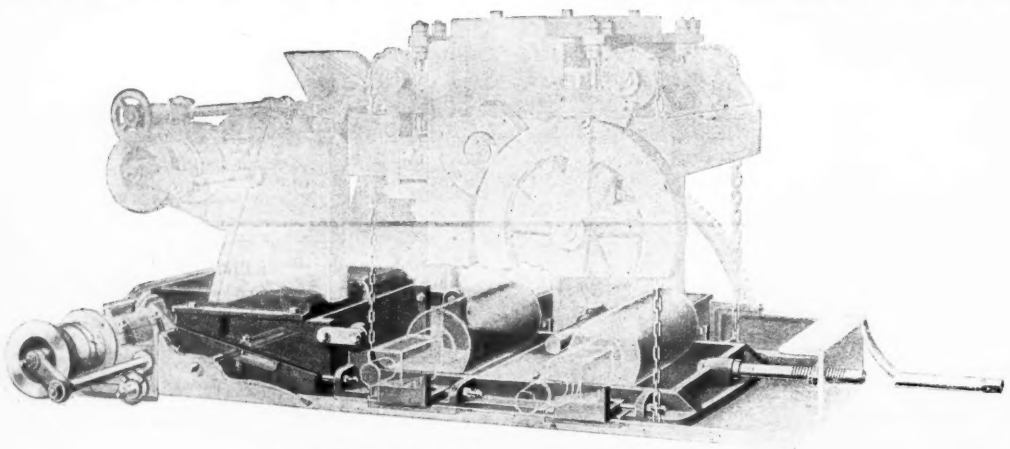


Fig. 1.

one of altering the relative position of the bottom head and the top head without changing the finished thickness of the stock, and to preserve the same relative position between the bottom head and matcher plates or platen after the cut, without disturbing either. This new improvement allows such a manipulation of the platens and the production of an excellent quality of finished stock. The location of the top and bottom cutter heads is such that a rigid platen is afforded, and clipping the ends of the stock is obviated. The adjustment of the lower feed mechanism and platen and the under cut is accomplished instantly without the use of wrenches or other instruments not a part of the machines.

Referring to Figs. 1 and 2, the operation of the device is explained as follows: The wedge platen, or bed



Wood's Adjustable Wedge Platen for Planing Machines.

plate, A, under the top cutter head forms a throat piece for the bottom head, J. This piece, A, rests on the wedge, B, which is simultaneously raised or lowered with the lower feeding in rolls by the wedge casting, C, and the wedge, F, thus increasing or diminishing the cut of head, J, as desired. The adjustment is made from the feeding-in end and is controlled by a rod fitted to the frame, E, which is plainly shown in the half-tone and to which the wedges, B and F, are connected. The platen plate, A, can be adjusted toward or away from the cutter head, J, to suit the projection of the knives, independently of adjustment of the wedge, B, and an effective clamping device is provided for locking the wedge platen at four points.

The advantages to be derived from this improvement are numerous. The cut of both heads may be changed

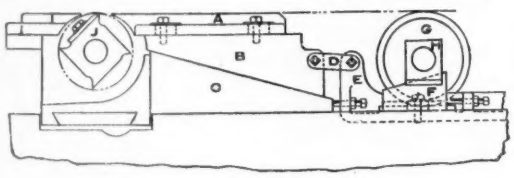


Fig. 2.

or distributed as desired, without altering the finished thickness of the stock or disturbing either cutter head or top rolls. Scant sawed lumber may be made to finish full, since the cut of the under head can be readily reduced to admit of saving from that side. The independent adjustment provided for the roll boxes allows for wear and facilitates planing crooked stock. For single surfacing the machine can be quickly adjusted without removing the belts. Besides these advantages in its operation the device has other advantages of a mechanical nature, particularly the provision which is made for wide bearings for the roll boxes instead of depending upon the point of a set screw. The platen can be leveled with the bed, after it has been necessary to re-dress it on account of wear, without difficulty.

The S. A. Woods Machine Company, of South Boston, has perfected this device, and it is embodied in its machines.

TECHNICAL.

Manufacturing and Business.

E. J. Ward Company, Chicago, has transferred its diaphragm department to the Railway Appliances Co., Chicago.

The Pittsburgh Filter Manufacturing Co. has moved its office from the Empire Building to the Farmers' Bank Building, Pittsburg, Pa.

The Sterlingworth Railway Supply Company has placed orders abroad for 3,500 tons of material for use in its enlarged rolling mill.

The Consolidated Cross-Tie Co., with a capital of $10,000,000 common stock, and $5,000,000 preferred stock, has been incorporated under the laws of New Jersey.

F. M. Brydges & Sons, Winnipeg, Man., and E. A. Jack, Jr., St. Louis, Mo., have been appointed representatives of the Northern Metallic Packing Co., St. Paul, Minn.

The Michigan Lubricator Co., Detroit, Mich., has received orders for 32 Improved Michigan locomotive lubricators for shipment to Scotland, and 40 for shipment to Germany.

George E. Martin, who for some time past has been with Pedrick & Ayer Co., New York, makers of special railroad machine tools and appliances, as superintendent of shops, has resigned.

B. E. Tilden Company, Chicago, which has sold the Tilden car and engine replacers to 825 railroads, will remove its offices from the Monadnock Block to 633 Manhattan Building on May 1.

H. Fernstrom, Chief Engineer of the New York Central, will receive bids up to 3 p.m., March 30, for the installation of steam piping and heating apparatus for the new station and subway at Troy, N. Y., on the Middle Division of the road.

A. Leschen & Sons Rope Co., St. Louis, has opened an office and warehouse at 1717-1723 Arapahoe street, Denver, where a full stock of wire and manilla rope will be kept. This company now has four branch offices and warehouses, the others being located at New York, Chicago and San Francisco.

The Newhall Chain, Forge & Iron Co. has incorporated under the laws of the State of New Jersey, the incorporators being Henry B. Newhall, Henry B. Newhall, Jr., and William A. Hengstenberg. The office is at 9-15 Murray street, New York, and the company makes chains for railroad and other work.

It is announced that Clarence Price, who has been purchasing agent of the Chicago & Alton since January, 1900, has been appointed New York agent for the American Car & Foundry Company. He will leave the Alton on April 1. Mr. Price will be succeeded by E. V. Dexter, the present fuel agent of the Alton.

Edgar M. Smith, formerly Roadmaster on the Burlington & Missouri River road in Nebraska, and previous to that on the New York, New Haven & Hartford and the Boston Elevated, has accepted a position with the Railway Appliances Company, Chicago, giving his time particularly to the "Q and C-Bonzano" rail joint.

The Otis Elevator Company has a contract for 18 electric elevators equipped with the push-button system of control, to be installed, one each, in a row of private residences now being built on 74th street, New York. The Franklin Institute recently awarded the John Scott Legacy Medal and Premium to this company for perfecting this type of elevator.

The St. Paul Railway Supply Mfg. Co., St. Paul, Minn., has a device called Dunn's frog and switch indicator, for locating frogs when laying new turnouts, and which may be carried in the pocket. It is claimed that it will yield as accurate results as a transit, and may be used by any railroad man, engineer or otherwise. It is direct-reading, is without complicated mechanism, and, it is claimed, will not get out of order or work inaccurately.

The Philadelphia Pneumatic Tool Company has made a contract with the Lake Shore & Michigan Southern to supply the road with all the pneumatic hammers to be used in the new Collinwood shops and on the entire road for a period of one year. This contract is awarded after a competitive test of all the different makes of pneumatic tools. This company has also received orders from the Wabash, the Delaware & Hudson and the Central of New Jersey.

The Consolidated Car Heating Co. has closed a contract with the Interborough Rapid Transit Co., for 12,680 electric heaters. Twelve thousand of the heaters are of the panel type, and 680 of the cross-seat type for cabs. There will be 24 panel heaters in each car, 20 of them being placed under the longitudinal seats and four under stationary cross-seats, which are to be paneled. The panel heaters are of Consolidated standard construction with cast-iron front and back.

The rapid encroachment of the gas engine in the hitherto exclusive field of its competitor, the steam engine, is well illustrated in the installation now operating in the plants of the Riter-Conley Manfg. Co., at Allegheny and Leetsdale, Pa., aggregating 1,600 h.p. of Westinghouse gas engines of the vertical single acting type. Three of the engines are 280 h.p., and are direct connected to polyphase generators arranged for parallel operation. These generators supply current for light and power in the new shops at Leetsdale. The remaining engines are used for driving air compressors, pumps, etc. The gas engine at both works supplies all the power.

The Consolidated Canal Company, of Mesa, Ariz., is arranging to furnish water for a large area and is installing in its power plant a 300 k.w., three-phase, revolving-field alternator, running at 400 r.p.m. and 11,000 volts, direct coupled to a water wheel; also three 50 h.p., type C motors of 200 volts, 7,200 alternations, and 850 r.p.m., which will be used in operating irrigation pumps. This machinery was built by the Westinghouse Electric & Mfg. Co. The British Westinghouse Electric & Mfg. Co. has also contracted to supply the Metropolitan District Railway Co., London, with four turbo-alternators, each of which will have a maximum output of 8,250 k.w. These turbines will be the largest steam-turbines ever made, and the most powerful single cylinder engines in existence. The dimensions are, 29 ft. long by 14 ft. wide, and 12 ft. high, the overall length of turbine and alternator being 51 ft. 9 in. The steam pressure will be 165 lbs. per sq. in., and the speed 1,000 r.p.m.

Iron and Steel.

The Milford Steel Co. has been incorporated in New Jersey with $30,000 capital.

Cambridge-Byesville Steel Co., Cambridge, Ohio, has been incorporated with a capital of $100,000.

The Peden Iron & Steel Co., of Houston, Texas, is reported to have increased its capital from $250,000 to $500,000.

The Union Chain & Steel Co. is reported about to change its name to the Union Iron & Steel Co., and it will reduce its capital.

The Steel & Iron Corporation of Mexico, with a capitalization of $1,600,000, has been incorporated in New Jersey, as successor to the Companie Industrial Mexicana.

The report of the Cambria Steel Co. shows net income from Nov. 1, 1901, to Dec. 31, 1902, to have been $5,056,962, out of which were paid three dividends amounting to $2,025,000.

The Stewart Works Co., of Cincinnati, Ohio, has been incorporated with a capital stock of $300,000, by R. C. Stewart, Jr., W. A. Stewart, H. L. Gordon, W. A. Rinckoff and W. L. Granger.

The Pacific-Jupiter Steel Co., San Francisco, Cal., is said to have acquired the Jupiter steel castings patents for the Pacific coast and begun the building of a mill to make steel castings from scrap.

Howard Williams has been appointed Superintendent of the American Steel Hoop Co.'s mills at Warren, Ohio, to succeed John W. Bennington, who has resigned to join the Youngstown Sheet & Tube Co.

The contract for 25,000 tons of rails for the Intercolonial Ry. has been awarded to Messrs. A. R. Kidston & Coof, Glasgow, Scotland. It is possible that the rails will be of German make, delivered through English agents.

Brakes for Electric Cars.

The St. Louis Transit Company has notified the city Board of Public Improvements that it has arranged to equip its 2,000 cars with air-brakes. Storage tanks will be used, with 300 lbs. per sq. in. initial pressure, and 40 charging stations are to be built in the city.

Tendency of Locomotive Construction in Prussia.

A recent official report of the Prussian State railroads says that of late years, in order to increase the capacity of the motive power, almost exclusively eight and ten-wheeled locomotives have been procured, for express, passenger and also for freight service, and the greater number of these have three or four cylinders, in this differing from the previous practice. For express service recently eight-wheeled tenders have been used, in order to carry water enough to run long distances without stopping. At present two locomotives are under construction intended to make much greater speeds than any now run, if it shall be found to be practicable. Further, after thorough trials of superheated steam of at least 510 deg., which seems to have proved material advantages over steam as heretofore used, 30 locomotives have been equipped for superheated steam, and more will probably be ordered.

A New Steel Dry Dock.

Bids were opened at the Navy Department last week for a large steel floating dry dock for the Naval Station at Cavite, P. I. The dock is to be not less than 500 ft.

long over all, 100 ft. wide in the clear and 35 ft. draft, and the decks of the side walls will be at least 8 ft. above water. The lifting capacity of the dock will be 16,000 tons, evenly distributed over its length, and no part of the dock or its connections will have a stress of more than 10,000 lbs. per sq. in. under the specified loads or of 15,000 lbs. per sq. in. in self-docking. The dock will be built of open hearth steel and so designed as to be readily self-docking without the aid of divers or auxiliary machinery and capable of being towed without auxiliary bracing. The appropriation now available for the dock is $1,225,000, and the bids were: The Maryland Steel Company, of Sparrows' Point, $1,085,000; The United States Shipbuilding Company, of New Jersey, $1,443,000, and the Chauncey N. Dutton Company, of New York, $1,105,000.

Plans For New Naval Ships.

A circular has been issued by the Navy Department describing the two 1,000-ton gunboats, bids for which will be opened at the Navy Department on May 10 next, the ships to be completed within 20 months. These vessels will be 174 ft. long, 35 ft. beam, with 12 ft. 3 in. draft and a speed of 12 knots an hour, although they may be accepted at a reduced price if they fall below 11 knots. They are intended for police duty in shallow waters, and will have composite hulls below the water line to admit of sheathing. They will carry six 4-in., four 6-pounder and two 1-pounder rapid fire, and two Colt automatic guns.

For the 13,000-ton ships authorized by Congress this winter, preliminary plans will be prepared for fast ships to make 22 knots, and for slow ships to make 17 knots, and on the completion of these plans the question of high speed and power, or heavy armor and armament will be decided.

The Naval Board on Construction has finally decided that the 16,000-ton battleships recently authorized shall be identical with the Connecticut and Louisiana type as to armor and armament, except that the superstructure armor shall be increased from 6 to 7 in., and the upper belt armor reduced from 11 to 10 in.

The New St. Louis Interlocking.

The contract for much the largest interlocking installation in the United States and probably much the largest in the world was let last week to the Union Switch & Signal Company. The plant to be installed will be on the Westinghouse Electro-Pneumatic System, and it takes the place of an installation on the same system made in 1894. This old installation of 131 levers must be taken out because of the entire rearrangement of the tracks, and no important amount of the old material can be used.

The new installation will include three towers. In these towers there will be 258 working levers and 51 spare levers, a total of 309. Signalmen nowadays speak of the work done by levers as so many functions. Using this expression these levers will operate 372 functions according to the lowest method of estimating, but if we give the proper value to the movements of double slip switches and movable point frogs and two-arm semaphores we should find that the total number of functions amounts to 748. These would require in a mechanical machine not less than 650 levers. Besides the machines and their necessary connections the signal company furnishes the towers, and some thirteen bridges which aggregate about 175 tons weight. The railroad company will furnish compressed air and electric power to the switchboard, but the signal company will furnish motor generators and storage batteries for the switch and signal workings, and also generators, switchboard, mains and all accessories for the electric lighting of signals, which will cover 238 lamps. The signal company also furnishes with this installation 54 track indicators, 32 train-ready annunciators and 83 fouling point indicators.

The work will be put in hand at once, and must of course be finished in good time for the World's Fair. It will be a good exhibit for the signal company at the Louisiana Purchase Exposition, but we are informed that this fact was not taken account of by the company in its bid.

Marking Flange Steel Plates.

The Association of Steel Manufacturers has adopted a ruling that hereafter no plates will be stamped at a higher tensile strength than the minimum of the order specified. In other words, plates to range in tensile strength from 55,000 to 65,000 lbs. will be stamped 55,000 lbs. Plates ranging from 52,000 to 62,000 lbs. will be stamped 52,000, etc. Heretofore manufacturers have been stamping commercial flange steel 60,000 lbs., with the understanding that the plates ran from 55,000 to 65,000 lbs.

Structural Steel Car Company.

The directors of the Structural Steel Car Co. on March 16, at Canton, Ohio, voted to increase the capital stock to $1,000,000. Mr. H. A. Cavanah, of Canton, was elected President, and Wm. Wagner, Vice-President. The eastern capitalists who have been negotiating to finance this enterprise have completed all arrangements and work will now be pushed to finish the plant. The New York office is 39 Cortlandt street.

The Pennsylvania Air Brake Company.

The Pennsylvania Air Brake Co. has been organized at Washington, Pa., and H. G. Manning, of the Washington Foundry & Machine Co., Washington, Pa., is President. The plant will consist of one building, 400 ft. long and 600 ft. wide, and is to cost approximately $250,000 without the machinery. Plans are now being made for this building, which is to be of structural steel.

Kennicott Water Softeners.

The Union Pacific has just placed with the Kennicott Water Softener Company, Chicago, an order for 25 more softeners, having a total capacity of 295,000 gals. an hour. This is the third order from the Union Pacific, the first being for an 8,000-gal. plant at Point of Rocks, Wyo. The second order was for 10, all but two of which were placed in Nebraska, the stations being Valley, Columbus, Grand Island, Kearney, Lexington, North Platte, Julesburg and Sidney. These are all 8,000 and 10,000 gal. plants except North Platte, which is 15,000. The other two stations are Council Bluffs, Iowa, 15,000 gals., and Cheyenne, Wyo., 20,000 gals.

The present order is distributed according to divisions as follows: Kansas Division—Lawrence, Topeka, Wamego, Junction City, Salina, Ellsworth, Dorrace. Colorado Division—Brighton, La Salle, Orchard, Agate, Lake, Deer Trail, Byers. Wyoming Division—Cooper's Lake, Rock River, Medicine Bow, Hanna, Rock Springs, Green River, Dana. Nebraska Division—Fremont, Schuyler, Paxton, Ogallala. These are all 10,000 and 15,000 gal. plants. The Pittsburgh & Lake Erie has placed a second order for nine Kennicott softeners, and the Chicago, Burlington & Quincy a second order for two.

The Kennicott Company has just issued a pamphlet containing fac-simile reductions of reports of examination of the water supply of the Middle Division of the Atchison, Topeka & Santa Fe. There are 29 stations, the incrusting solids in grains per gallon for which range from 9.61 to 105.42 before treatment. These show a reduction to 5 gr. in most cases, with a number at 5.5. A chart shows these values graphically, enabling ready comparison. Another chart gives the number of pounds of incrusting solids in the untreated water entering the boilers at each station in 24 hours. These values, which range from 4.03 to 696.5, are also presented graphically, as well as numerically. Analyses of the water for each station are given, and also a report showing for each station the present average daily consumption; the hourly capacity of the softener in gallons; hours softener will run; height in feet from ground softener will deliver water; storage capacity, gallons.

European City Water Supplies.

In anticipation of the appointment of the special water commissioner to investigate new sources of supply and check the prevailing waste, the Merchants' Association of New York engaged the services of Mr. Columbus O. Johnson, formerly Water Registrar of New York, to go abroad and investigate the water system of the principal cities in Europe. Mr. Johnson has published his report on the systems used in London, Birmingham, Manchester, Liverpool, Glasgow, Cologne, Berlin and Paris. A description is given of the methods used in detecting leakage and preventing waste, which have such good effect that in Liverpool, for example, the per capita consumption is about a fourth of that in New York.

THE SCRAP HEAP.

Notes.

The Trunk Lines, excepting the New York Central, have agreed on a thirty-dollar 1,000-mile rebate interchangeable mileage book, and the books will be put on sale May 1.

The Worcester Polytechnic Alumni Association of New York held a meeting at the Hotel Albert, 11th street and University place, on Tuesday evening, March 17. The association includes 75 graduates of the Institute. The next meeting will be held at the same hotel on April 28.

In the Federal Court at Cleveland, Ohio, the United States District Attorney has brought suit against the Lake Shore & Michigan Southern, and other railroads, to enforce the order of the Interstate Commerce Commission requiring a reduction in the rates for transportation of hay, as decided by the Commission on the application of the National Hay Association last October. The hearing is set for June 15.

Following the establishment of the new passenger station at 32nd street, West Philadelphia, the Pennsylvania Railroad will, on April 5, abandon the stations at Powelton avenue, Engleside and Ridge avenue. Stations formerly maintained at 40th street (West Philadelphia) and at Zoological Garden were abandoned some months ago, so that hereafter local trains going out on the New York division will make their first stop at Germantown Junction, 5.4 miles from Broad street; on the Philadelphia division at 52nd street, 4 miles; and on the Philadelphia, Baltimore & Washington at Darby, 6.1 miles.

Japanese Railroads.

There are in Japan 5,854 miles of railroad, including government and private lines, and the total capital (460,768,544 yen) is approximately $230,384,272. The rolling stock was increased during 1902 by 71 locomotives, 113 passenger and 1,483 freight cars, making a total of 1,350 locomotives, 4,529 passenger coaches, and 19,820 freight cars. The total number of passengers carried decreased 2,499,663, while the quantity of freight carried increased 8,232 tons. Traffic earnings were $24,202,274, an increase of $1,735,076, and operating expenses, $11,719,588, an increase of $1,357,956. In commenting on the report, gratification is expressed at the prominent part which England took in building the pioneer lines in Japan, one connecting the former capital Kyoto with its seaport, Kobé, and another connecting Tokyo, the present capital, with Yokohama. Both of these lines were completed in 1872 by British engineers. In 1881 German and American interests claimed the field, the former building the Kiushu railroad, and the latter the Hokhaido line.

No marked change occurred in the condition of Japanese railroads until 1897, when 125 locomotives were ordered from the United States by the Imperial and Nippon railroads, both large private lines. Since that time the importation of English locomotives has never greatly exceeded that of American. The Kiushu and San-Yo (private) railroads also ordered locomotives from the United States, giving as their reason the lower price and shorter time required for filling orders; and finally in 1901, the Japanese Government added the Schenectady works of the American Locomotive Company to its list of approved makers.

The Union Station at Washington.

Work on the new railroad terminal in Washington will begin in a few weeks, and it is expected that it will be completed in three years. The total cost will approximate $14,000,000, of which $3,000,000 will be borne by the District of Columbia, the balance being divided almost equally between the Baltimore & Ohio and the Pennsylvania Railroads. The new station will be on Massachusetts avenue and the plans are being drawn by D. H. Burnham, the celebrated architect. The train shed will contain 28 tracks. The approach from the east will be over a four track elevated stone structure, along the line now used by the Metropolitan Branch of the Baltimore & Ohio, the Pennsylvania building a connection from a point east of Bennings. The Washington Branch of the B. & O. will be diverted west of Hyattsville, and its Washington terminals for roundhouse and other purposes constructed near Eckington. All lines entering Washington from the south will reach the new station by means of a double-track tunnel, 4,900 ft. long, under Capitol Hill. It has been decided that the B. & O. will build the elevated structure, the Pennsylvania the terminal and Mr. Burnham the station. The terminal improvements will be controlled by a Terminal Company, owned jointly by the B. & O. and Pennsylvania.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xvi.)

Canadian Society of Civil Engineers.

At the meeting on March 26, at 877 Dorchester street, Montreal, a paper on "The Gradient Telemeter Level," by R. W. Macintyre, A. M. Can. Soc. C. E., will be read and illustrated by lantern projections.

The New York Railroad Club.

At the last meeting of the New York Railroad Club, held on March 20, it was announced that the paper on "Signaling on Single-Track Railroads," which was to be presented at the April meeting, had been postponed. In its place will be given a paper by Professor B. E. Fernow, of Cornell University, on the subject of "Forestry, and its Connection with the Railroad Tie Question, with the Metal Tie in the Horizon." It was also announced that another paper by Professor Hermann von Schrenk would probably be presented on some subject pertaining to timber preservation.

Railway Club of Pittsburg.

The Pressed Steel Car Company has extended an invitation to the Railway Club of Pittsburg to visit its McKees Rocks plant Friday afternoon, March 27. Arrangements have been made, through the courtesy of J. W. Riley, Superintendent of the Lake Erie Division of the Pittsburgh & Lake Erie Railroad, to run a special train for the club members. At night at the Hotel Henry the regular monthly meeting of the club will be held in conjunction with the usual smoker. A paper on "Steel Cars Without Center Sills" will be read by E. W. Summers, a structural engineer.

St. Louis Railway Club.

The regular March meeting of the St. Louis Railway Club was held at 3 p.m., Friday, the 13th. A paper by Geo. J. Tansey, President of the St. Louis Transfer Company, entitled "The St. Louis Transfer Company and its Relation to the Railroads," was read. The paper treated on the transfer of baggage and passengers to and from the station and hotels and residences and of its handling of freight between the railroad warehouses of both sides of the river and its patrons; the transfer company acting as the agents of the railroads, paying charges and taking care of traffic in transit, handling charges on the same to the extent of over a million dollars a month.

The transfer company had as high as 20,000 packages of freight a year to hold and handle on account of error in address, etc. Seven hundred horses were in service, together with its vast equipment of trucks, vans, carriages, omnibuses and wagons.

Discussion on the paper, "The Flexible Car Truck," presented at the January meeting, was continued and an animated debate participated in by Messrs. Flatau, Squires, Noble and others, followed.

Report of the committee appointed on "Revision of Rules of Interchange" was presented for transmission to the arbitration committee of the Master Car Builders' Association as the recommendation of this club.

At the next meeting, the annual election of officers will take place, followed by a paper on "Railroad Surgery," prepared by Dr. H. C. Fairbrother. This meeting will be held in the evening at the Mercantile Club.

American Institute of Electrical Engineers.

The following announcements of future meetings have been made by the American Institute of Electrical Engineers:

March 27.—High Tension Lines. 1. Introduction, President Scott. 2. Mechanical Specifications for a Proposed Standard Insulator Pin, by Ralph D. Mershon, Consulting Electrical Engineer. 3. The Testing of Insulators, by F. O. Blackwell, Engineer with General Electric Co. 4. Transposition and Relative Location of Power and Telephone Wires, by P. M. Lincoln, Engineer with Westinghouse Electric & Mfg. Co. 5. Burning of Wooden Pins on High-Tension Transmission Lines, by C. C. Chesney, Chief Engineer, Stanley Electric Mfg. Co. 6. Model Showing Distribution of Electromotive Force and Current Along a Single-phase Alternating Current Transmission Line, by W. S. Franklin, Professor of Physics and Electrical Engineering at Lehigh University.

LIST OF FUTURE MEETINGS.

April 17.—Extra Meeting.—This meeting will be held at the Chemists' Club, 108 West 55th street, New York. 1. Introduction, President Scott. 2. Radium and Other Radioactive Substances, and Certain Phosphorescent and Fluorescent Substances. The Properties and Applications of Selenium. The Treatment of Disease by Ultra-Violet Rays, by Wm. J. Hammer, Consulting Electrical Engineer.

April 24.—Tendencies of Central Station Development.—1. Introduction, President Scott. 2. Economical and Safe Limits in Size of Central Stations, by H. A. Lardner, Engineer with J. G. White & Co. 3. Safety Devices in Central Stations and Sub-stations, by Phillip Torchio, Associate; Engineer with the New York Edison Co. 4. Multiple versus Independent Operation of Units and Central Stations, by Peter Junkersfeld, Engineer with the Chicago Edison Co.

May 19.—Induction Generators.—1. Introduction, President Scott. 2. A New Induction Generator, by Wm. Stanley, Member; Electrical Engineer and Inventor. 3. The Experimental Basis for the Theory of the Regulation of Alternators, by B. A. Behrend, Chief Engineer, Bullock Electric Manufacturing Co. 4. The Heyland Motor, by C. A. Adams, Jr., Assistant Professor of Electrical Engineering at Harvard University.

ANNUAL CONVENTION.

Niagara Falls, June 29-July 3, 1903.—Arrangements for the annual convention are being made by the Committee on Papers. Members and Associates who desire to present papers at the convention, or suggest topics for discussion, are requested to communicate at once with the Chairman of the Committee, Samuel Sheldon. The following is a partial list of promised papers: The Energy Transformations in the Synchronous Converter, by W. S. Franklin; The Storage Battery in Sub-stations, by W. E. Goldsborough; Commercial Alternator Design, by W. L. Waters; Central Station Economies, by W. E. Goldsborough; Engineering English, by T. J. Johnston; Car Run Tests, by W. E. Goldsborough; Predetermination in Railroad Work, by F. W. Carter. A joint meeting with the Society for Promotion of Engineering Education will be held on Friday, July 3.

The Chicago Branch on March 10 gave an informal smoker and held a 30 minute discussion of the following papers on Railroad Train Lighting: An Electric Car Lighting System, by William L. Bliss, President of the Bliss Electric Car Lighting Co.; Axle Lighting, by Elmer A. Sperry, Electrical Engineer; An Axle Light System of Train Lighting, by Arthur J. Farnsworth, Engineer with the Consolidated Railway Electric Lighting & Equipment Co.; Mr. C. Locke Etheridge, Electrical Engineer for the Pullman Company, opened the discussion.

On March 24 the Chicago transportation problem was discussed. This was a joint meeting of the American Institute of Electrical Engineers and the Western Society of Engineers, at which Mr. Bion J. Arnold presented a resumé of his recent report to the City Council, illustrated by lantern slides.

April 7.—High Tension Lines.—Mechanical Specifications for a Proposed Standard Insulator Pin, by Ralph D. Mershon, Consulting Electrical Engineer; The Testing of Insulators, by F. O. Blackwell, Engineer with General Electric Co.; Transposition and Relative Location of Power and Telephone Wires, by P. M. Lincoln, Engineer with Westinghouse Electric & Mfg. Co.; Burning of Wooden Pins on High-Tension Transmission Lines, by C. C. Chesney, Chief Engineer, Stanley Electric Mfg. Co.

May 5.—Tendencies of Central Station Development.—Economical and Safe Limits in Size of Central Stations, by H. A. Lardner, Engineer with J. G. White & Co.; Safety Devices in Central Stations and Sub-stations, by Phillip Torchio, Engineer with the New York Edison Co.; Multiple versus Independent Operation of Units and Central Stations, by Peter Junkersfeld, Engineer with the Chicago Edison Co.

May 19.—Telephone Evening.—A special programme of papers and discussions by local telephone experts is being prepared under the direction of Kempster B. Miller, Engineer Kellogg Switchboard & Supply Co., and Angus S. Hibbard, General Manager Chicago Telephone Company.

A full list of papers to be read in the near future may be had from the Secretary, Ralph W. Pope, 95 Liberty street, New York.

PERSONAL.

—Mr. John R. Duval, of Baltimore, Md., Central Passenger Agent of the Seaboard Air Line, died suddenly March 21, at St. Augustine, Fla.

—Mr. Edwin H. Witter, at one time Superintendent of the Pittsburgh Division of the Buffalo, New York & Philadelphia, died recently.

—Mr. Charles E. Whitehead, of New York City, formerly President of the New York, Pennsylvania & Ohio, died at Aiken, S. C., March 22, aged 73 years. Mr. Whitehead was also at one time President of the Des Moines & Ft. Dodge.

—Mr. Joseph H. Sands, formerly General Superintendent of the Eastern District of the Southern Railway at Salisbury, N. C., will, after April 1, be engaged in the coal business. Mr. Sands will be associated with Messrs. Castner, Curran & Bullitt, and will be located at Roanoke, Va.

—Mr. Robert Blum Olney, for some years connected with the engineering department of the Norfolk & Western, died at San Antonio, Texas, March 4, aged about 30 years. Mr. Olney's home was at Charleston, S. C., and he was graduated from Lehigh University in 1892 as civil engineer.

—The new Superintendent of the Bradford Division of the Erie Railroad, Mr. J. H. Taylor, has been continuously with this company since 1879. Starting as a freight clerk and operator he continued in similar duties of this kind at different points until 1886. In May of that year he was appointed train despatcher, which position he held for 10 years. He was made chief despatcher, then trainmaster on the Erie & Wyoming Valley, and for a year previous to his new appointment Mr. Taylor was operator on the Erie Division of the Erie.

—Mr. K. G. Morley, the new Superintendent of the Valley Division of the St. Louis, Iron Mountain & Southern at Mer Rouge, La., was born in 1860. His railroad service dates from 1876, when he began as baggagemaster on the Chicago & Alton. He remained with this company until 1880, when he became train despatcher on the Chicago & Eastern Illinois, but the next year he returned to the Chicago & Alton. For one year (1883-1884) he was with the Chicago, St. Paul, Minneapolis & Omaha. From 1886 to 1891 he was in the service of the Colorado Midland, which he left to become chief despatcher of the Rio Grande Junction. Later he went to the Iron Mountain, where he has been chief despatcher, trainmaster and (since March 1) Superintendent as above.

—Mr. George T. Slade, who has been General Superintendent of the Erie Railroad at Jersey City for some time, is, according to reports, to succeed Mr. Ward as General Superintendent of the Great Northern. Mr. Slade thus goes back to the same company in whose service he gained his early experiences. He is 32 years old and is a graduate of Yale University class of '93. Mr. Slade entered railroad service in that year, beginning as a clerk in the general office of the Great Northern, and continued with that road until he was made General Manager of the Erie & Wyoming Valley. In 1894 he was roadmaster of the Cascade Division of the Great Northern, and then, in 1895 chief clerk in the Superintendent's office of the Eastern Railway of Minnesota at West Superior. The next year he was appointed Assistant Superintendent, and in 1897 Superintendent. He was later made General Manager of the Erie & Wyoming Valley.

—On the first of the coming month Mr. George Van Keuren, General Superintendent of Transportation of the Erie Railroad, will succeed Mr. Slade as General Superintendent of the Erie Division at Jersey City. Mr. Van Keuren was born in Jersey City in 1861. His railroad career began in 1880, as a chainman on the New York & Albany (West Shore). In 1884 he became Assistant Engineer on the New York, Lake Erie & Western, and has since then stayed in the Erie service as follows: In 1887 as roadmaster; in 1890, Superintendent of the Jefferson Division; in 1894, Superintendent of Transportation; then General Superintendent of the Erie Lines East of Salamanca, and finally General Superintendent of Transportation, which position he has held until now.

ELECTIONS AND APPOINTMENTS.

Arkansas Southern.—G. W. Hunter has been elected President, succeeding J. W. Brown; and W. H. Crouch succeeds T. J. Gaughan as Secretary.

Atchison, Topeka & Santa Fe.—F. J. Easley, Division Superintendent at Newton, Kan., has been transferred to Las Vegas, N. Mex., succeeding F. C. Fox, who in turn succeeds Mr. Easley at Newton. The office of Division Superintendent F. T. Dolan has been transferred from Fort Madison, Iowa, to Marceline, Mo.

Baltimore & Ohio.—On April 1, two new assistant treasurerships will be created and C. W. Rhodes, Baltimore, and E. N. Devereux, New York, will be the first incumbents.

Canadian Northern.—J. P. Driscoll has been appointed Superintendent of Car Service.

Canadian Pacific.—J. E. Schwitzer has been appointed Division Engineer of the Central Division, with headquarters at Winnipeg, succeeding J. Woodman, resigned, and A. S. Dawson becomes Division Engineer of the Western Division, at Calgary, effective April 1.

Central Indiana (Chicago & South Eastern).—Joseph Robinson has been elected President.

Chicago & Alton.—Clarence Price, Purchasing Agent, with headquarters at Chicago, Ill., has resigned, effective April 1. (See St. Louis & San Francisco.)

Chicago, Milwaukee & St. Paul.—J. H. Hiland, heretofore Traffic Manager, has been elected Third Vice-President, succeeding A. C. Bird.

Chicago, Rock Island & Pacific.—J. B. Kilpatrick has been transferred and is to be Master Mechanic of the Northern District, with headquarters at Cedar Rapids, Iowa. D. D. Robertson succeeds Mr. Kilpatrick as Master Mechanic at Herington, Kan. A. H. Powell has been appointed Superintendent of shops, with headquarters at Horton, Kan.

Choctaw, Oklahoma & Gulf (Rock Island).—J. M. Stark has been appointed Principal Assistant Engineer, with headquarters at Little Rock, Ark.

Cleveland, Akron & Columbus.—W. Tallant, heretofore Division Freight Agent of the Pennsylvania Company at Richmond, Ind., has been appointed General Freight Agent of the C., A. & C., with headquarters at Columbus, Ohio, succeeding Wm. Hodgdon.

Colorado & Southern.—J. W. Dean has been appointed Superintendent, with headquarters at Denver, Colo., succeeding T. H. Sears, resigned. F. S. McNamara has been appointed Purchasing Agent, with headquarters at Denver, succeeding Joseph Ost, resigned.

Delaware, Susquehanna & Schuylkill.—The title of L. C. Smith has been changed from Superintendent to Manager, the duties of the office remaining the same.

Erie.—George Van Keuren, heretofore General Superintendent of Transportation, has been appointed General Superintendent of the Erie Division, with headquarters at Jersey City, N. J., succeeding G. T. Slade, resigned; effective April 1.

Kansas Southwestern.—E. L. Kingsbury has been elected President, succeeding D. H. Nichols, and Mr. Kingsbury is succeeded as Secretary and Auditor by H. R. M. Smith. The offices of both are at Arkansas City, Kan.

Missouri, Kansas & Texas.—George Morton has been appointed General Passenger Agent, with headquarters at St. Louis, succeeding James Barker, deceased.

National of Mexico.—G. J. Dwan, heretofore Assistant General Freight Agent, has been appointed Acting General Freight Agent; and F. E. Young has been appointed Acting General Passenger Agent.

New York Central & Hudson River.—A. M. Waitt, Superintendent of Motive Power and Rolling Stock at New York, has resigned, effective April 1. J. F. Deems, General Superintendent of Motive Power, Rolling Stock and Machinery, will assume the duties. E. E. Davis, Assistant Superintendent of Motive Power, will retire, probably about May 1.

Pennsylvania.—B. F. Crawford, Cashier, will retire under the pension rules, April 1.

Pennsylvania Company.—See Cleveland, Akron & Columbus.

St. Louis & San Francisco.—J. E. Hutchinson, heretofore Trainmaster on the Chicago & Alton, has been appointed Division Superintendent of the St. L. & S. F., with headquarters at Sherman, Texas.

St. Louis, Iron Mountain & Southern (Missouri Pacific). George Dickinson has been appointed Master Mechanic, succeeding A. Harrity, resigned.

Southern.—S. J. Collins, General Superintendent of the Eastern District at Greensboro, N. C., announces the appointment of an Assistant to himself; A. Gordon Jones, heretofore Superintendent at Alexandria, Va.

Terre Haute & Logansport.—See Vandalia Line.

Vandalia.—J. O. Crockett has been appointed Superintendent of the Terre Haute & Logansport, with headquarters at Logansport, Ind., succeeding F. T. Hatch, and Mr. Hatch in turn succeeds Mr. Crockett as Superintendent of the Peoria Division, with headquarters at Terre Haute, Ind.

West Side Belt.—G. E. Edmonston has been appointed General Superintendent, with headquarters at Pittsburg, Pa.

LOCOMOTIVE BUILDING.

The Tionesta Valley is having one locomotive built by H. K. Porter & Co.

The Baltimore & Ohio is having 10 locomotives built at the Schenectady Works of the American Locomotive Co.

The Chicago Junction is having three locomotives built at the Schenectady Works of the American Locomotive Co.

The Tennessee Central, as reported in our issue of Feb. 13, has ordered six simple 10-wheel locomotives from the American Locomotive Co., for July, 1903, delivery. Total weight, 152,000 lbs.; weight on drivers, 118,000 lbs.; diameter of drivers, 68 in.; cylinders, 20 x 26 in.; extended wagon top boiler, with a working steam pressure of 200 lbs.; tank capacity, 5,000 gal.; coal capacity, nine tons. The special equipment will include Westinghouse air-brakes, Tower couplers, Pyle National electric headlights, Seller's injectors, Safety Car Heating & Lighting Co.'s steam heat equipment, Latrobe tires on driving wheels, truck wheels and tender wheels and cast-steel wheel centers.

The Santa Fe Central, as reported in our issue of Feb. 20, is having five simple locomotives built at the Pittsburg Works of the American Locomotive Co., for June, 1903, delivery. These locomotives will weigh 162,000 lbs., with 132,800 lbs. on drivers; cylinders, 20 in. x 26 in.; diameter of drivers, 61 in.; extended wagon top boilers, with working steam pressure of 200 lbs.; 314 2 in. tubes 13 ft. 7 in. long; fire-box, 120 in. long and 39 in. wide; tank capacity, 4,500 gal. and 12 tons of coal. The special equipment will include Westinghouse-American air-brakes, Gollmar bell ringers, M. C. B. automatic couplers, Monitor injectors, Coale's safety valves, Leach sanding devices, Railway Steel Spring Co.'s springs and Midvale open-hearth steel tires on driving wheels.

The Atchison, Topeka & Santa Fe will build six simple Atlantic and six simple Prairie type locomotives at its new Topeka shops. The Atlantic locomotives will weigh 163,000 lbs., with 93,000 lbs. on the drivers, and have 20 x 26 in. cylinders, 73 in. drivers and extended wagon top boilers, with a working steam pressure of 200 lbs.; heating surface, 3,075 sq. ft.; 340 tubes, 2 in. in diameter and 16 ft. 4 in. long; wide fire-box, 102 in. long and 71¼ in. wide; grate area, 50.4 sq. ft.; tank capacity, 6,000 gallons of water and 10 tons of coal. The Prairie locomotives will weigh 208,000 lbs., with 142,000 lbs. on the drivers, and have 22½ x 28 in. cylinders, 69 in. drivers and straight boilers, with a working steam pressure of 200 lbs.; heating surface, 3,716 sq. ft.; 298 tubes, 2¼ in. in diameter and 19 ft. long; wide fire-box, 108 in. long and 71¼ in. wide; grate area, 53.5 sq. ft.; tank capacity, 6,000 gallons of water and 10 tons of coal. The special equipment for both classes will include: American Brake Co.'s air-brakes, Ross-Mehan brake-shoes, Handy couplers, A., T. & S. F. headlights, Simplex injectors and Crosby safety valves.

CAR BUILDING.

The Pullman Company is building 10 coaches for general service.

The American Car & Foundry Co. has miscellaneous orders for 26 cars.

The Oregon Short Line has ordered two baggage cars from the Pullman Co.

The Scioto Valley Traction has ordered 10 motor bodies from the American Car & Foundry Co.

The Mineral Range has ordered 100 stock and 50 box cars from the American Car & Foundry Co.

The Cincinnati, Richmond & Muncie is having 200 freights built at the Laconia Car Company Works.

The Keystone Coal & Coke Co. is having 225 freights built by the Cambria Steel Co., Johnstown, Pa.

The Belardina Mining & Smelting Co. is having 15 freights built by Wonham-Magor (29 Broadway).

The Missouri Pacific has ordered 4,500 box and 500 stock cars from the American Car & Foundry Co.

The Pennsylvania is having 500 freights built at the Detroit Works of the American Car & Foundry Co.

The Western Maryland is having 21 coaches built at the Wilmington Works of the American Car & Foundry Co.

Thebaud Bros. (New York) are having one coach built at the Wilmington Works of the American Car & Foundry Co.

The New York Central & Hudson River has ordered 1,000 hopper gondola cars of 80,000 lbs. capacity from the Pullman Company.

The Los Angeles Ry. has ordered 35 passenger cars from the St. Louis Car Co. It has also placed an order with the Pullman Company for rebuilding 31 single truck cars built in 1895.

The St. Joseph & Grand Island has ordered 50 box cars of 80,000 lbs. capacity from the Western Steel Car & Foundry Co., in addition to the recent order of 200 cars reported in our issue of March 13.

The Pennsylvania, as reported in our issue of March 20, has ordered 100 cars from the Cambria Steel Co., Johnstown, Pa. These cars are to be 40 ft. steel gondolas, with drop bottoms and 45 in. sides.

The Atchison, Topeka & Santa Fe will build 24 refrigerator cars of 60,000 lbs. capacity at its new Topeka shops for the Santa Fe Refrigerator Despatch Co. The cars will be 40 ft. long, 8 ft. 2¾ in. wide, inside measurement, and 7 ft. 3 in. high, inside measurement. The special equipment will include: M. C. B. axles and brake shoes, Westinghouse air-brakes, M. C. B. brasses and couplers, Miner draft rigging and M. C. B. journal boxes and lids.

F. M. Hicks, of the Hicks Locomotive & Car Works, has received an order to build one chair car and one 60-ft. baggage car for the Bessemer & Lake Erie. Miscellaneous freight car orders have also been received from the Missouri, Arkansas & Western, Union Traction Co., (Indiana) Coal Belt Ry. Co., Fairbanks, Morse Mfg. Co., Central Arizona and the Detroit & Mackinac. An order to build two eight-wheel cabooses has also been received from the Santa Fe Central.

The New York, Ontario & Western, as reported in our issues of Nov. 14 and March 20, has ordered six passenger and two parlor cars from Harlan & Hollingsworth. These cars will be 66 ft. long and 10 ft. wide, and weigh about 103,000 lbs. Special equipment will include Gould axles, couplers, draft rigging, platforms and vestibules; Harlan & Hollingsworth bolsters, journal boxes and journal box lids, Westinghouse brakes, American Brake-Shoe & Foundry Company's brake-shoes, "Fabrikoid" curtains, "Frost Light," N. Y., O. & W. standard trucks, and Railway Steel Spring Company's springs and wheels.

BRIDGE BUILDING.

ALBION, IND.—John L. Henry, County Auditor, will receive bids until April 7, for three steel bridges and two stone and brick arches, to be built in the county.

AUXVASSE, MO.—It is said that the bridge over the Auxvasse Creek is to be replaced by a new iron bridge. The old bridge is 640 ft. long and over 100 ft. high.

BEAUMONT, TEXAS.—Jefferson County is planning to issue bonds for road and bridge purposes.

BEAVER FALLS, PA.—A three-span county bridge 105 ft. long is to be built over Beaver Creek at a cost of about $12,500.

BLUFFTON, IND.—The County Auditor will receive bids until April 7 for 15 new bridges for Wells County.

BOISE, IDAHO.—It is said that $20,000 has been appropriated for a bridge over Kootenai River at Bonner's Ferry.

BRIDGEPORT, OKLA. T.—Fremont Boyle, County Clerk, Anadarko, Okla. T., will receive bids until 6 p.m., April 16, for a three-span steel bridge to be built over the Mound Valley Creek in Caddo County.

BUFFALO, N. Y.—The Board of Aldermen has passed a resolution appropriating $6,000 for a temporary bridge in South Michigan street, over the City Ship Canal.

CHATHAM, ONT.—It is said that the County Council will build a steel bridge over Long's Creek.

CHIPPEWA FALLS, WIS.—The Wisconsin Central bridge near this city has been destroyed by fire.

CONNERSVILLE, IND.—The County Commissioners will receive bids until March 28 for repairing a bridge across Williams Creek, and building stone arches on the Everton Road, and in Orange Township.

CRESTLINE, OHIO.—The Ohio Central Traction Co. is having plans prepared for a bridge over Wiley street.

DANVILLE, PA.—The Delaware, Lackawanna & Western is to erect a single span steel bridge over Mahoning Creek at the Reading Iron Works.

ERIE, PA.—Bids will be received by the Chairman of the joint session of Councils in the Common Council Chamber up to 8 p. m., April 7, for building a steel bridge of about 500,000 lbs., in the Buffalo Road over the railroad tracks.

FORT STEELE, B. C.—Measurements have been taken for a new bridge over Elk River.

GRAND FORKS, N. DAK.—Wm. Ackerman, County Auditor, will receive bids until April 6 for steel required for bridges to be built in this county during the year 1903.

GRAND RAPIDS, MICH.—A viaduct is proposed over the railroad yard south of the Union Station.

GRETNA, NEB.—The Elkhorn bridge has been carried away by high water.

HAMILTON, MONT.—The County Commissioners are asking bids for two new bridges in Ravalli County.

HARRISBURG, PA.—Charters have been granted to the Beaver Bridge Co., to build bridges in Beaver County, Pa.; the Beaver Falls & New Brighton Bridge Co., to build bridges over the Big Beaver Creek in Beaver County; and the Rochester Bridge Co., each with a capital stock of $20,000.

HAYDEN, OHIO.—The County Commissioners have authorized a revision of plans for the superstructure, substructure and approaches to the bridge over Scioto River.

HELENA, MONT.—The County Commissioners are considering replacing a number of wooden bridges in this county by steel structures.

INDIANAPOLIS, IND.—The County Commissioners are asking bids for seven new bridges in Marion County.

INDIANOLA, NEB.—Two bridges near this place have been carried away by high water. Bridges at Barclay and at McCook have also been badly damaged.

LINDEN, PA.—H. Fernstrom, Chief Engineer, writes that, contrary to newspaper reports, the New York Central is not planning to build a steel bridge over the Susquehanna River at this place in connection with the Pennsylvania R. R.

MCKEESPORT, PA.—The Pittsburgh, McKeesport & Connellsville and the city are receiving bids for building a bridge over White's Hollow, on Versailles avenue, to replace a wooden structure. The railroad is to pay halt the cost which is expected to be about $15,000.

J. W. Patterson, General Manager, writes that there is no truth in the report that the Wabash is to build a bridge over the Monongahela River from this place to Duquesne.

MERIDIAN, MISS.—It is said that plans have been prepared for a 300-ft. bridge to be built across the tracks at Fortieth avenue.

MILWAUKEE, WIS.—Plans for the West Water street bridge over the Menomonee River have been approved by the United States Engineer.

NEW YORK, N. Y.—The Erie Railroad will soon build a foot bridge over West street at the Chambers street ferry.

The Interborough will build four new bridges. (See General Railroad News.)

PEKIN, ILL.—The Supervisors are said to have appropriated $6,500 for two new bridges.

PITTSBURG, PA.—Plans have been finished for the proposed bridge of the Wabash Railroad across the Allegheny River to Allegheny City. The War Department will have to pass upon them.

PORTLAND, MICH.—Bids will be received by the County Commissioners until 10 a. m., April 9, at the Hotel Divine, for a two-span steel bridge, each span to be 112 ft., and substructure, to be built over the Grand River between this place and Danville. Joseph T. Angell, Belding, Mich., is Chairman of the Roads & Bridge Committee.

PORTLAND, ORE.—The question of a bridge across the Willamette River at Morrison street has been ordered by the Legislature to be submitted to popular vote, to be taken next June.

The City Engineer is said to be making plans for a bridge over Marquam Gulch.

RATON, N. MEX.—Bids will be received until April 6, by the Probate Clerk, for a 40-ft. bridge at Arroya.

REDBANK, PA.—It is said that the Pennsylvania has approved plans for a bridge over the Allegheny River.

RICHMOND, VA.—It is said that the Virginia Passenger & Power Co. will soon advertise for bids for its new bridge over James River.

ROCKDALE, IOWA.—Plans have been prepared for a new viaduct over the Illinois Central tracks.

SAN BERNARDINO, CAL.—Bids will be received by L. A. Pfeiffer, County Clerk, until noon, April 13, for a two-span five-panel riveted span bridge across Warm Creek on Colton avenue, east of the city of Colton; and a four-span five-panel riveted span bridge over the Santa Ana River at Tippecanoe avenue.

SAN DIEGO, CAL.—It is proposed to issue $5,000 of bonds for two new bridges.

SAN JOSE, CAL.—It is said that the County Surveyor is preparing plans for a steel bridge over Coyote River.

SCHENECTADY, N. Y.—The Council has been petitioned to build a bridge over Brandywine Pond.

SCOTTDALE, PA.—John H. Brown, County Comptroller, Greensburg, Pa., will receive bids until noon, April 16, for a joint bridge over Jacob's Creek at Keister's Mills.

SHELBYVILLE, IND.—The County Council is said to have appropriated $2,500 for a bridge over Little Blue River in Union Township.

TACOMA, WASH.—The city is to build a 240-ft. bridge over the Puyallup River, to cost $14,000. Bids have not yet been advertised. R. W. Clark, Commissioner of Public Works.

TOLEDO, OHIO.—Preparations are being made to bridge Sandusky Bay.

WHEELING, W. VA.—The City Railway Co. is said to have prepared plans for the new Market street bridge.

WILLIAMSPORT, IND.—The County Commissioners have approved plans, and appropriations have been made for 13 new bridges. Contracts will be advertised on April 11.

Other Structures.

ANNISTON, ALA.—The malleable and soft foundry buildings of the Southern Car & Foundry Co. were recently burned, causing a loss of about $30,000.

AVENUE, PA.—It is reported that the Allegheny Iron & Steel Co. will soon enlarge the capacity of its works and establish a new department to make ornamental steel.

BEATRICE, NEB.—The Burlington will probably build a new depot at this place.

BIRMINGHAM, ALA.—J. M. Barr, General Manager, writes that the Seaboard Air Line will build a new roundhouse at this point, with the other buildings customary at division terminals. No contracts have yet been let.

BOWDON, N. DAK.—The Northern Pacific depot was recently burned.

CINCINNATI, OHIO.—The American Structural Iron Co., recently incorporated, will build a plant to make structural material.

CLEVELAND, OHIO.—It is said the Pennsylvania will build a new roundhouse here, with accommodations for about 15 engines.

CLINTON, ILL.—It is said that the Illinois Central is preparing plans for a $135,000 roundhouse.

CRESTLINE, OHIO.—It is reported that the Pennsylvania Lines West of Pittsburg are planning extensive yard and shop improvements, including a roundhouse and freight station.

DUQUESNE, PA.—It is said that the Pennsylvania will build a new $20,000 depot opposite the present station building at Oliver.

ELK CITY, KAN.—The Santa Fe depot has been destroyed by fire.

ELLWOOD, PA.—The Standard Engineering Co. has increased its capital stock from $200,000 to $300,000 for the purpose of building a new foundry.

EVANSVILLE, IND.—The Louisville & Nashville will build a roundhouse at Howell, the building and machinery for which will cost about $100,000.

EVERETT, WASH.—It is rumored that the Great Northern will build freight car shops at the terminal yard.

HIGHBRIDGE, N. J.—The Taylor Iron & Steel Co. is planning to enlarge its plant.

IRONDALE, WASH.—The Pacific Steel Co., according to report, is planning to double the capacity of its furnace and to build another furnace, open-hearth steel plant and bar mill.

JENNISON, MICH.—The plant of the Jennison Iron & Engine Works has been destroyed by fire at a loss of about $50,000.

LA CROSSE, WIS.—The La Crosse Bridge & Steel Co. will soon begin work on a new plant.

MILWAUKEE, WIS.—The Milwaukee Steel Structural Co., formerly the Milwaukee Bridge Co., has increased its capital stock from $25,000 to $125,000, and will soon put up a structural steel plant.

MOLENA, GA.—Southern Ry. station has been destroyed by fire.

NEW YORK, N. Y.—Contract for building a steel frame pier shed for the New York Central at pier 34, East River, has been awarded to the Snare & Triest Co., the lowest bidder.

PITTSBURG, PA.—It is said that the S. Jarvis-Adams Co., founders, will remove its plant to Neville Island and enlarge the same to double its present capacity.

SAN FRANCISCO, CAL.—The United Railroads Co. is reported to have bought 12 acres of land at the junction of San Jose and Ocean House roads, on which shops are to be built, to cost about $200,000.

WAYCROSS, GA.—The South Atlantic Car & Manufacturing Co. has been organized, with a capital of $250,000, to erect a car-building plant.

WILMERDING, PA.—The Westinghouse Air Brake Co. will at once begin the erection of a new foundry 320 ft. x 65 ft., of brick, with steel frame, west of the present works.

WINNIPEG, MAN.—The Vulcan Iron Works proposes adding a molding shop, 200 ft. x 100 ft. to its buildings this year.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALASKA CENTRAL.—Press reports state that this road, which is projected from Resurrection Bay, Alaska, north via Lake Kenai and Cariboo Pass, to Atwood on the Tanana River, 415 miles, will shortly be built. Geo. Dickinson, Tacoma, Wash., is President and General Manager. (See Construction Supplement.)

ATLANTIC CITY & SUBURBAN TRACTION.—Press reports state that this company will build an electric line from Atlantic City west to Pleasantville, N. J., with branches northeast to Absecon and southwest to Somer's Point, a total distance of about 18 miles.

BATTENKILL (ELECTRIC).—This company has been granted authority by the State Railroad Commission to build an electric line from Greenwich, N. Y., to Schuylerville, 10 miles. H. C. Gray, Greenwich, is interested. (See Construction Supplement, March 13.)

CALIFORNIA ROADS.—An application has been filed by John H. Hammond, New York, for a franchise to build and operate a railroad, either steam or electric, from Visalia, Cal., east to Farmsville, and thence northeast to Exeter and Lemon Grove, 10 miles. The projected line will pass through a section of orchard and fruit lands which is now without transportation facilities. It is said that work will be begun as soon as the franchise has been granted.

CANADIAN NORTHERN.—It is reported that application will be made by this company at the present session of Parliament for permission to build three additional branches in Manitoba—one from Sterling in an easterly

direction to Morris; from Hartney in a northwesterly direction to Regina in Assiniboia, and from a point on the Swan River through the Swan River valley to the Saskatchewan River.

CANADIAN NORTHERN RY.—The Manitoba Legislature has passed an act guaranteeing the bonds of the Canadian Northern to the extent of $10,000 a mile, for about 300 miles of branch lines. The projected lines include lines from Sperling to the southern boundary of the province near St. Ann; from near Portage la Prairie to Brandon; from Swan River to the western boundary of the province; and from near Greenway westerly. A. McMillan, of Westbourne, Man., has been awarded a contract to grade 65 miles of an extension, commenced last year, from Clanwilliam to Rossburn.

CANADIAN RAILROADS.—The report of the Dominion Government on steam railroads for the fiscal year ending June 30, 1902, shows the following number of miles now being built in the different provinces: Algoma & Hudson Bay, 180 miles; Great Eastern 82 miles, Baie des Chaleurs 23 miles, both of which are branches of the Atlantic & Lake Superior; Cape Breton, 30 miles; Cobourg, Northumberland & Pacific, 49 miles; Crow's Nest Southern, 48 miles; Cumberland Ry. & Coal Co. (Canadian Pacific), 14 miles; Halifax & Yarmouth, 61 miles; James Bay, 5 miles; Kettle River Valley, 4 miles; Lindsay, Bobcaygeon & Pontypool, 4 miles; Nova Scotia Southern, 117 miles; Quebec, bridges and approaches, 10 miles; Restigouche & Western, 100 miles; St. John Valley & Riviere du Loup, 6 miles; Tilsonburg, Lake Erie & Pacific, 15 miles; Vancouver & Lulu Island, 17 miles. Total, 766 miles.

CENTRAL OF ARKANSAS.—Articles of incorporation have been filed by this company in Arkansas. It is proposed to build a line north and south, 150 miles, through the counties of Logan, Yell, Perry, Montgomery and Garland. A. Molitor, J. C. Hart, W. W. Garner, W. R. Abbott and others, of Little Rock, Ark., are interested.

CHEASAPEAKE & OHIO.—Contracts have been awarded for second track on the Peninsula Division from Richmond, Va., east to Newport News, 20 miles, and for 70 miles of second track between Clifton Forge, Va., and Charleston, W. Va.

CHOCTAW, OKLAHOMA & GULF.—It is announced that this company will make the following improvements on its line during the coming year: Forty miles of road between Memphis, Tenn., and Little Rock, Ark., and 20 miles between Little Rock and Hot Springs will be ballasted. Ten miles of new 80-lb. steel rails will be laid west of Bridge Junction, and the Eastern Division will be re-ballasted for a distance of about 60 miles.

DEL NORTE & HUMBOLDT.—This company has been incorporated in California, to build from Eureka north to Crescent City, approximately 100 miles. Five branches will also be built—one eight miles long, up Humboldt Creek; one up the Klamath River, 10 miles; one up Little River, eight miles; one along Redwood Creek, 12 miles, and one from Arcata up Mad River, 15 miles. Hiram C. Smith, San Francisco, is one of the incorporators.

DENVER, NORTHWESTERN & PACIFIC.—An officer writes that contracts for 150,000 ties have been let to the Emporia Lumber Co. and the Continental Lumber Co., both Texas firms. Surveys for this line from a point 36 miles out of Denver to Kremmling, Colo., are now being made, and contracts for grading will soon be let.

FORT WAYNE & GOSHEN.—This company, which was recently incorporated in Indiana, has completed its plans for building its line. The proposed route begins at Goshen and runs in a southeasterly direction to Fort Wayne, paralleling the Cleveland, Cincinnati, Chicago & St. Louis to New Paris, 55 miles; it crosses the Baltimore & Ohio at Syracuse, and the Toledo & Michigan Southern at Churubusco. (See Construction Supplement.)

GRAND TRUNK PACIFIC.—Application is being made at the present session of Parliament asking for the power to build and operate an extension of this road from a point near the city of Quebec southwest to Gravenhurst on North Bay, Ont.

GREENWICH (ELECTRIC).—This electric line was opened for traffic on March 22. It runs from Port Chester, N. Y., northeast to Greenwich, Conn., 10 miles, and forms the connecting link for a continuous trolley service between New York and New Haven.

HUDSON & MANHATTAN.—This company was incorporated on March 20, in New York, with a capital of $3,000,000. It proposes to build a tunnel approximately one mile long, from Broadway and Cortlandt street, under the Hudson River to a point in Jersey City not yet determined. It is reported that options have been obtained on three block fronts between Liberty and Fulton streets. G. P. Lester, Bloomfield, N. J.; Howard Slade, New York City; Robert C. Maroney, Brooklyn, N. Y.; Abram Proctor, Boonton, N. J., and others are directors. Jacobs & Davies, 128 Broadway, New York City, are the engineers.

HURON & BRUCE (ELECTRIC).—A bill is now before the Ontario Legislature to amend the charter of this company. The new road, as proposed, will run from Dungannon, Ont., northeast to Lucknow, and thence to Walkerton, 35 miles. H. Morrison, Lucknow, Ont., is interested.

ILLINOIS CENTRAL.—Contracts for the double tracking between Fulton and Memphis have been let as follows: Fulton to Paducah Junction, 10 miles, and Millington to Woodstock, seven miles, to J. D. Lynch, Monmouth, Ill.; Trimble to Dyersburg, 17 miles, to C. D. Smith & Co., Birmingham, Ala., and Dyersburg to Atoka, 37 miles, to McArthur Bros., Chicago. (See Construction Supplement, March 13.)

INDIANA HARBOR.—Articles of incorporation have been filed by this company. It is proposed to build from Indiana Harbor on Lake Michigan, southwest through Lake, Newton, Benton, Warren and Vigo Counties, in Indiana, to Sullivan, Ind. C. W. Hotchkiss, and F. R. Babcock, Chicago, Ill., are said to be interested.

KOKOMO, MARION & WESTERN TRACTION.—An officer writes that this Indiana electric line will shortly be built between Kokomo and Marion. Surveys are now in progress and contracts will shortly be let. O. V. Darby is President; T. C. McReynolds, Secretary, Kokomo, Ind. This is the same project as that reported in our Construction Supplement under the heading of Kokomo-Marion.

MANILA RAILWAY & LIGHT CO.—This company has been incorporated, with a capital stock of $1,000,000, to build and operate lines in the City of Mexico and the Philippine Islands. J. G. White, 29 Broadway; Frank H. Buhl, Sharon, Pa.; H. J. Conant, 10 Bridge street, New York City, and others, are incorporators. (March 20, p. 220.)

MEMPHIS & GULF.—The Cornell Construction Co. has been incorporated in New Jersey, with a capital of $1,000,000, for the purpose of building this line from Memphis, Tenn., south to Pensacola, Fla., about 366 miles. C. H. Pond, Morehead, Miss.; C. H. Blair and O. H. P. Cornell, New York City, are interested.

MICHOACAN SOUTHERN.—It is reported that work will shortly be begun on this line in the State of Michoacan, Mexico. The proposed route is from Irapuato, south via Puruandrio, to Morelia, where a connection will be made with the National R. R. of Mexico. From Morelia the line will run south to Tacambaro and thence west to Ario. W. E. Powell is interested.

MIDLAND RAILWAY (NOVA SCOTIA).—It is reported that this company is planning an extension from Windsor southeast to Middleton, in Annapolis County, Nova Scotia. The road has recently settled difficulties with its former contractors.

MISSOURI PACIFIC.—In the annual report of this company for the year ending Dec. 31, 1902, the following construction work is reported in progress: Arkansas and Louisiana State line south to Clayton, La., 102 miles; grading completed and track laid from State line to a point three miles south, and from Clayton 2½ miles north. White River Junction, Ark., to Buffalo, 82 miles; track laid to Mt. Olive, 42 miles; grading completed for about 90 per cent. of the remaining 40 miles. Arkansas and Louisiana State line to El Dorado, Ark., 44 miles; track laid to Ouachita River, 7½ miles, and 65 per cent. of remainder graded. From a connection with the Lexington & Southern Division north of Carthage to Asbury, Mo., 18 miles; 90 per cent. of the first 10 miles out of Carthage is graded. From a point near Batesville, Ark., to the Pfeiffer stone quarries, 5 miles; 60 per cent. completed. Detour at Yates Center, Kan., 8½ miles long, reducing distance of present line two miles; about 60 per cent. completed.

NEW CASTLE & EASTERN.—A charter was granted this road on March 13 to build a steam line from New Castle, Orange County, Pa., east to Rose Point, 10 miles. Edwin N. Ohl, New Castle, is President; Geo. Greer, E. F. Norris, John E. Norris and others of New Castle, are directors.

NEW YORK RAPID TRANSIT.—Ground was broken in Joralemon street, Brooklyn, on March 24, for the first shaft of the Manhattan-Brooklyn tunnel. The proposed route of this line is from a connection with Manhattan-Bronx line at the intersection of Broadway and Park Row, to the Battery, and thence under the East River, and under Joralemon and Fulton streets to the Flatbush avenue station of the Long Island R. R., Brooklyn. The entire line must be completed in three years, according to the contract. (See July 11, p. 562.)

NORTH DAKOTA ROADS.—The Pembina Portland Cement Co. proposes to build a line from Edinburg, N. Dak., north via Gardar and Mountain to mines at the foot of Pembina Mountain, a distance of 21 miles.

NORTHEAST TEXAS.—An officer writes that the proposed route of this road is from Redwater, Texas, in a southwesterly direction to Cusseta, and eventually to Texarkana, 53 miles. The road is being built by the company's forces, and is primarily for logging purposes. It is now completed for a distance of 14 miles. G. Munz, Redwater, Texas, is President, and R. A. Gray, Chief Engineer. (See Construction Supplement.)

PENNSYLVANIA.—Surveys have been completed for building a new four-track freight line from Radebaugh east to Millwood, on the Pittsburgh Division, 18½ miles. Bids will shortly be asked.

PENNSYLVANIA ROADS.—Rights of way are now being secured for a new road from Bolivar, Pa., south to Ligonier, in Westmoreland County, 14 miles. Oliver & Snyder, who recently purchased about 1,000 acres of coal lands in Ligonier Valley, are the projectors.

PENSACOLA, MERIDIAN & NORTHWESTERN.—It is reported that this line will shortly be built from Pensacola, Fla., northwest through Meridian, Miss., to Winona or Grenada, Miss., with a probable extension to Memphis, Tenn. W. V. Belhaut, St. Louis; M. F. Smith, Vicksburg, and John A. Lewis, of Meridian, Miss., are all interested.

PICKENS & ADDISON.—A charter has been granted this company to build from Pickens, in Randolph County, southwest to Addison, in Webster County, 15 miles. E. A. Beckley, New Haven, Conn.; F. O. Havener, Parkersburg, W. Va., and J. F. Johnson, Pickens, are incorporators.

PIEDMONT ELECTRIC.—A charter is being asked by this company to build an electric line from Atlanta, Ga., northeast via Alpharetta to Cumming, 40 miles. E. S. Brazelton, Birmingham, Ala.; Chas. K. Maddock, J. A. Tiller and John Burnett and others, of Atlanta, Ga., are interested.

QUEEN ANNE'S R. R.—Press reports state that an extension will shortly be built from Hobbs, Md., southeast via Sharptown, Snow Hill and Salisbury to a point on the State line between Maryland and Virginia, near Chincoteague Island, about 80 miles. The line now runs between Queenstown, Md., and Lewes, Del., 60 miles. Wm. H. Bosley, Kent Island, Ind., is President.

SARNIA, PETROLIA JUNCTION & ST. THOMAS.—A charter is being asked for by this company to build from Sarnia, Ont., east via Petrolia Junction to St. Thomas, 60 miles. The proposed route will parallel the Grand Trunk as far as Petrolia Junction. J. D. Stewart, Sarnia, Ont., is interested.

SHINGLEHOUSE R. R.—This company has been chartered in Pennsylvania, to build a railroad (steam) from a point on the State line between New York and Pennsylvania, from Ceres, McKean County, Pa., southeast to Shinglehouse, Pottery County, four miles. W. R. Page, Olean, N. Y., is President; Geo. W. Dodge and John W. Cole, Shinglehouse, Pa., are directors.

SOUTHERN PACIFIC.—This company, which recently purchased the Carson & Colorado, is shipping rails to Mojave, Cal., from the abandoned Central Pacific track in Utah and Nevada. From this fact it is deduced that the company anticipates extending the Carson & Colorado line to Mojave. It is also reported that the road will be extended in a northerly direction to connect with the Central Pacific at Reno, Nev.

SOUTH SAN FRANCISCO R. R. & POWER CO (ELECTRIC).—Articles of incorporation have been filed by this company in San Francisco. It is proposed to build 14 miles of electric line in the counties of San Francisco and San Mateo. W. J. Martin, W. R. Abbott, J. R. Sloan and J. H. Hurd, San Francisco, are directors.

TACOMA TERMINAL.—Articles of incorporation for this new company have been filed in Washington. It is proposed to build a belt line about 10 miles long around the city of Tacoma, connecting with all the interurban lines, and also with the Northern Pacific. J. W. Lynch is President, and E. L. Roberts, Vice-President, both of Tacoma.

VINCENNES-JASPER (ELECTRIC).—The survey for this interurban traction line from Vincennes southeast to Jasper, Ind., 40 miles, has been completed. The Union Trust Co., of New York City, will finance the road. It is reported that work will be begun early in the summer. The headquarters of the company will be at Vincennes. N. H. Kennedy, Rockport, Ind., is said to be interested.

WAYNESBURG & WASHINGTON.—It is reported that the contract for changing this road to standard gage has been let to Kerbaugh & Co., of Philadelphia. No statement has yet been made with regard to the exact time when the change will be made, but it is expected that work will be begun within a few weeks. The total length of the line is 29 miles, from Waynesburg, Pa., to Washington.

YREKA R. R.—This line, which runs between Montague, Cal., and Yreka, is to be extended from Yreka in a southerly direction by way of Fort Jones and Etna Mills to Scott, about 20 miles The road will parallel the Southern Pacific for a distance of about six miles out of Yreka.

GENERAL RAILROAD NEWS.

CANADIAN PACIFIC.—A decision has recently been handed down in the High Court of Manitoba which, if confirmed, will save the Canadian Pacific a large sum. According to the contract in 1881 with the Canadian Government, the railroad was given 25,000,000 acres of land. As each 20 miles of road was built, the company was entitled to select a certain quantity of these lands. The road was completed in May, 1886. By this decision it is claimed that the 20 years' exemption from taxation on lands in the Northwest Territory began at date of patenting, and not, as contended by the Government, at the completion of the road, in 1886.

CANADIAN RAILROADS.—The report on steam railroads recently published by the Dominion Government for the fiscal year ending June 30, 1902, contains the following items of interest: Number of miles of track completed, 574. Gross earnings, $83,666,503, an increase of $10,767,754. Operating expenses, $57,343,592, as against $50,368,726 last year, leaving an increase in net earnings of $3,792,888. Passenger train miles, 21,104,036, and freight train miles, 24,891,813, making a total increase in train mileage of 2,380,462. The amount of Government (Dominion and Provincial) bonuses paid was $185,182,371, an increase of $7,541,606.

CENTRAL OF INDIANA.—This company has been formed by the Cleveland, Cincinnati, Chicago & St. Louis and the Pennsylvania railroad companies, as the successor of the Chicago & Southeastern, recently foreclosed. The line runs from Muncie, Ind., to Brazil, 127 miles.

CUMBERLAND VALLEY.—Gross earnings for the year ending Dec. 31, 1902, were $1,256,501, as against $1,120,111 in 1901, an increase of $136,390. Operating expenses were $869,174, an increase of $190,123, leaving a decrease in earnings of $53,734. Freight earnings increased $103,086, and passenger earnings $36,865. Charges to maintenance of way and structures amounted to $228,766, an increase of $64,818, due in large part to the repairs made necessary by the serious floods of Feb. 26 to 28 in the Cumberland Valley. The large increase of $82,388 in conducting transportation is due chiefly to the greater consumption and cost of fuel for locomotives.

DAYTON, SPRINGFIELD & URBANA (ELECTRIC).—It is reported that this company has increased its capital from $500,000 to $1,500,000. The increase is made in order to provide for a large number of improvements over the entire line, and for a second track between Springfield and Dayton.

INDIANAPOLIS, COLUMBUS & SOUTHERN TRACTION.—Chandler & Bros., Philadelphia, are offering at 102½ and interest the $300,000 of the $1,000,000 first mortgage 5 per cent. bonds, due Feb. 1, 1923. This line now runs from Indianapolis south via Southport and Whiteland, to Franklin, 18 miles. An extension to Columbus is about finished. Gilbert Hodges, Indianapolis, is Engineer.

MONTREAL STREET.—Negotiations are now being made to consolidate this company with the Montreal Light, Heat & Power Co., with a total capitalization of $50,000,000. No official statement has yet been given out.

NEW YORK CITY INTERBOROUGH.—This company, recently organized in New York, has been granted a franchise to build a new double-track line in the Bronx, 36 miles long, and including four bridges. According to the terms of the agreement, the city will receive 3 per cent. from the gross earnings for the first five years and 5 per cent. for the remaining 20 years. It will also receive $4,000 annually on each bridge, increasing to $6,000 at the end of five years. The franchise is for 25 years, with the privilege of renewal for 25 years more.

PERE MARQUETTE.—This company has purchased the South Haven & Eastern, which runs from Lawton northwest to South Haven, 36 miles; the Milwaukee, Benton Harbor & Columbus, from Benton Harbor south to Buchanan, 27 miles, and the Benton Harbor & Colima, between Benton Harbor and Paw Paw Lake. Part of the South Haven & Eastern will be used as a link for a short line between Detroit and Chicago.

QUEBEC TERMINAL & RY.—This company has applied to Parliament for an act authorizing it to amalgamate with the Quebec Bridge Company. The Quebec Bridge Company is seeking an act with power to build from the northern terminus of the bridge to Quebec, and from the southern terminus to a connection with the Intercolonial or Grand Trunk.

SAN FRANCISCO & SAN JOSE (ELECTRIC).—A mortgage has been filed with the Union Trust Co. of San Francisco, as trustee, to secure $3,000,000 of the $1,000 5 per cent. gold bonds, due Jan. 1, 1933. Of this number, the sum of $500,000 is outstanding. The new company is to build an electric line between San Francisco and San Jose, and to operate a ferry between San Francisco and Emeryville. E. A. Heron, San Francisco, is President.

TEXAS & PACIFIC.—The gross earnings of this road for the fiscal year ending Dec. 31, 1902, were $11,236,601, a decrease of $533,341. Operating expenses were $7,752,290, a decrease of $282,160, leaving a decrease in net earnings of $251,181. The heavy floods in Texas made necessary a large expenditure for new steel rails and ballasting.